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A REPORT
ON THE
INFLUENCE OF MILK
IN
SPREADING ZYMOTIC DISEASE

WITH A TABULAR ANALYSIS OF FORTY-EIGHT OUTBREAKS.

BY
ERNEST HART, D.C.L.,

EDITOR OF THE "BRITISH MEDICAL JOURNAL;"

CHAIRMAN OF THE PARLIAMENTARY BILLS COMMITTEE OF THE BRITISH MEDICAL ASSOCIATION.



Reprinted from the "British Medical Journal."

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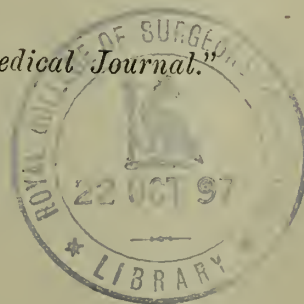
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INTRODUCTION.

It is now just upon sixteen years since I read my paper at the International Medical Congress of 1881 on the Influence of Milk in Spreading Zymotic Disease. I was at that time able to place on record 73 outbreaks of disease as having been traced to the agency of milk. Of these, there were 50 in which enteric fever was in question, 15 were of scarlatina, and 7 of diphtheria. I dealt in my paper in brief with the history of infectious disease as traceable to milk, and went on to show what were the lessons which were to be learned as a result of a consideration of the several outbreaks and their surrounding circumstances, with suggestions for further legislative action.

This paper, with its voluminous abstracts and tables, was printed in the *Transactions* of the Congress. Some important administrative improvements have followed, and the paper and tabulations have served as a mine of facts and references for subsequent writers at home and abroad. It has seemed to me, however, that the time has come when it would be advantageous to compare the intervening years' experience with our previous knowledge of milkborne disease, and to see how we stand to-day in the matter. Accordingly, I have issued extensively systematic series of queries to all medical officers and others concerned with any milk epidemics of which I have been able to find either casual or other notice, and have carefully tabulated them and endeavoured to supplement and to organise on a uniform basis all the available information which I have been able to procure from various sources on this subject. The labour has been very considerable, and has extended over no small period of time, but I hope that the results will be considered commensurate. Thus I have have striven to render as complete as possible the history of milkspread infectious disease since 1881. At the same time I may as well state at the outset that I have had occasion to omit many so-called "milk outbreaks" on account of the scanty thread which ran through the argument for milk as the *vera causa* of the particular epidemic, and I have included only such as have seemed to me to bear the light of close investigation upon them in this connection. There are other and well founded milk outbreaks which find no place in my summary of facts by reason of my ignorance of the circumstances; of this I feel quite sure, as it seems impossible to cull all the data necessary for a complete and absolutely comprehensive record of milkborne occurrences of infectious maladies. But if these things be, they only serve to emphasise the magnitude of the statistics of preventable sickness which are in evidence in relation with milk as a cause. I am, therefore, the less troubled at the absence of record of local outbreaks of which others may know, though I should have been glad if my publicly expressed desire for information of facts had included the missing data. And here I would take the opportunity of tendering my sincere thanks to those health officers who have kindly responded to my wishes, and have placed at my disposal their own personal experience of milkspread disease. To the reports of the Medical Department of the Local Government Board, also, I am greatly and largely indebted, the admirable manner in which the facts arising in connection with the investigated occurrences have been handled having facilitated my deductions in no small degree.

As on the last occasion, I have stated the particulars of the recorded outbreaks in the abstract under the following headings:

- 1, Date of outbreak; 2, locality; 3, reporter; 4, total number of cases; 5, deaths; 6, number of cases amongst drinkers of infected milk; 7, percentage to total cases; 8, number of families supplied by milkman; 9, number of such families invaded; 10, percentage; 11, sanitary circumstances of farm or dairy from which milk was derived; 12, exciting cause of outbreak; 13, circumstances implicating milk; 14, facts showing special incidence of the disease; 15, references to sources of information.

The 73 outbreaks in my 1881 abstract have given place to an additional 95 on the present occasion—namely, typhoid fever 48, as against 50; scarlatina 32, as against 15; and diphtheria and allied throat ailments 15, as against 7. I am confident even so that these but touch the fringe of the matter, especially if I had sought abroad for evidences of epidemics traced to milk. As a matter of fact, I have been content to locate myself to the four quarters of the United Kingdom, except in one or two instances where special trouble has been taken to bring to my notice the recorded facts.

FRESH ELEMENTS SINCE 1881.

It will be unnecessary for me to in any wise refer to the question of causation of disease by the agency of milk as being contentious in any degree. As far back as the seventies the matter was practically placed within the pale of certainty, and assuredly by 1881 the public had come to recognise the relationship between milk and disease as clearly proven. At the same time the matter has undergone rapid development, to a large extent due to the very able and elaborate investigations conducted by Mr. W. H. Power, F.R.S., the assistant medical officer of the Local Government Board, whose lucid reports, aided by the bacteriological inquiries of Dr. Klein, have demonstrated beyond doubt that there is direct causal relationship between conditions of milch cows and disease in the human subject, in the cases of diphtheria and scarlatina. The Hendon outbreak of 1885, of which I shall have occasion to speak, has become classical in the region of epidemiology, the relationship of teat and udder eruptions in the milch cow to scarlatina in man having been brought prominently forward in masterly fashion in the papers published by the late Sir George Buchanan, and containing reports from the pens of Mr. Power, the late Dr. Cameron of Hendon, and Dr. Klein. It is the recognition of the cow as herself having to do with the infective quality of her milk that has chiefly marked the last ten or twelve years in the direction of added knowledge as to milkborne disease. It has been a hard fight to secure the verdict of veterinary authorities in favour of the view held at Whitehall, but just as the theory of aërially-spread small-pox had to be maintained in the face of great opposition, finally to be accepted by the leading public health experts of the day, so has the theory of cowborne maladies had to be contended for, but the result in the long run has been the same.

I therefore am in the pleasant position to-day of being able to start at once on a short statement of the chief facts given in my abstract, without the necessity of having to prove that milk can cause infectious sickness. My task is rather to demonstrate wherein lie the principal needs for further care in the processes of dairying and the like; and the task is of a nature to afford sanitarians with material for uncomfortable reflection, seeing that its fulfilment must bring out facts which are to our national discredit.

First of all, then, I will deal with those phases of disease outbreaks which are exhibited by two or all three of the diseases which form the bulk of local occurrences finding place in my abstract.

OBSTRUCTIVE DIFFICULTIES IN LOCAL INQUIRIES.

I may perhaps at the outset refer to a circumstance which militates against attempts to elucidate the origin and method of spread of milkborne disease, and that is the wilful withholding of information pertinent to the success of the investigation. Such withholding has in the past been practised on more than one occasion and by more than one class of individuals. Take, for example, the case of the outbreak of diphtheria at Ealing in January, 1887 (No. D. 8), and inquired into by Mr. Power for the Local Government Board, where the reporter states that mainly default of evidence was due to disregard by particular people in Ealing of appeals made to them directly and individually for information on the

subject of the outbreak. Thus of 19 medical practitioners personally urged by the Ealing Sanitary Authority to give information, and furnished with forms for facilitating its record and transmission, not more than 11 supplied facts of the sort asked for; other 8 either sending no reply at all or refusing the names and addresses of their patients. Some few, too, of private residents in the place believed to have suffered throat illness in their families disregarded the application made to them by Mr. Power by circular letter; among them being a gentleman, a customer of the suspected dairy, who had lost a child by diphtheria.

SPECIAL INCIDENCES OF MILKBORNE DISEASE.

In some outbreaks traced to milk the incidences on special sections of the community have been excessively heavy or singular. These sections have sometimes been whole villages, at other times they have been merely the residents in some very restricted local area, or even a single dwelling. In the case of an outbreak of concurrent scarlatina, diphtheria, and throat illness at Upton, in February, 1889 (No. S. 18), as many as 77 per cent. of the households using the implicated milk were invaded, and 37 per cent. of the contained members were attacked. In the case of an outbreak of scarlatina at Glasgow in August, 1892 (No. S. 24), out of 193 families supplied with a particular milk service in one round, there were 57 families invaded and 91 individuals attacked; whilst of 166 families on another round there were 37 families invaded and 59 individuals attacked. Moreover, in one street 21 families, being more than half those supplied with the milk, were invaded, and yielded 29 cases.

CONCURRENT DISEASES.

Another feature of milk outbreaks not altogether infrequently met with is the concurrence at the same place, and, indeed, in some instances in the same individual, of multiple diseases. In the case just before mentioned—that of Upton—which, together with the adjacent town of Macclesfield, was visited by a milkborne epidemic, the three diseases of scarlatina, diphtheria, and allied throat maladies, were concurrent in the invading localities. The outburst was of scarlatina, quite suddenly, after long absence of the disease; in addition, much throat mischief was prevalent, and there were two undoubted cases of diphtheria.

Other instances of special incidence are deserving of brief notice. As Bush Hill Park (No. S. 21) all the cases of scarlatina were in drinkers of the particular milk, and 33 cases arose in 22 households; and in the dairyman's own family the infant fed on "nursery" milk escaped, and another child taking the implicated milk was attacked. At Hastings, in 1893 (No. S. 27), of 20 boys in a school, the only patients were 2 who partook of the suspected milk separately each morning. In Canterbury, in 1886 (No. D. 6), of 196 houses supplied either wholly or in part by the milk, 115 were invaded by diphtheria in a period of eight days. In a family taking other milk at home, the only case was of a member who took the suspected milk in his tea at a friend's house. At Clapham, in 1882 (No. T. F. 3), in a family of 15 persons, only 1 was attacked, and he the only drinker of the milk in a raw state. At St. Albans, in 1884 (No. T. F. 15), 1 visitor to the farm in question as causing typhoid fever by its milk supply, and who drank one glass of milk, was attacked. In Edinburgh, in 1890 (No. T. F. 27) in a household of 9 members the only one attacked was a young adult who nightly partook of a large quantity of milk on coming home from a hard day's work. In the case of typhoid fever caused by the ingestion of ices in Greenwich and Rotherhithe in 1892 (No. T. F. 43), 2 boys living in different streets, but eating ice creams from the same street vendor were the only members attacked in their respective households; and a servant girl, who visited the invaded district on Sundays, and who partook of ices therein, was the only one of her mistress's household attacked.

HELP FROM UNPROMISING FACTS.

The special significance of some apparently unpromising facts in the course of the elucidation of problems surrounding milk outbreaks has been noticed in some cases, and this particularly in the instance of the renowned scarlatina epidemic at Hendon and in North London, in 1885 (No. S. 10), where Mr. Power was bothered by the exceptional absence of scarla-

tina from one locality taking milk from the farm which seemed to be spreading the disease in the other quarters using the milk. But he was able to demonstrate that the locality in question did not at the time of its clean bill of health receive milk from certain cowsheds at the farm; when at a later date it also began to suffer from the malady in the person of the milk drinkers, it was found that the cows which in this case were the media of infection had been transferred from infected sheds to the sheds whence the locality was supplied. Hence the facts were after all found to have significance tending further to inculcate the implicated milk. And when the milk was prohibited in London, it was found to be causing scarlatina among persons at Hendon to whom it had, on its rejection by London, been clandestinely given.

HOUSING OF MILCH COWS.

Some amount of attention is, as will be readily agreed, necessary to the conditions of housing of milch cows. In the case of Hastings, in 1893 (No. S. 27), the cowsheds outside the district were badly drained and ill-paved, and deficient in ventilation; and Dr. Scarlyn Wilson, the health officer, is of opinion that the febrile condition of the cows noticed was doubtless due to the insanitary character of their housing. The milk in question at St. Helens, in connection with an outbreak of typhoid fever in 1895 (No. T. F. 46) came from a shippin which was in a filthy state, and in which cows and pigs were both housed, the floor being rubble-paved, a gully being in the shippin, and inches of animal manure littering the place. These are conditions for which there can be adduced no reasonable excuse, cleanliness being one of the prime essentials of all dairying businesses.

FARMERS AS SCAVENGERS.

Dr. Brown, of Bacup, has drawn attention to the case of a dairy farmer who combined the occupation of dairy farming with that of scavenger, having in the latter capacity to see to the removal of night soil. Dr. Brown very properly animadverts on this strange and dangerous multiplication of offices, pointing out how easy it is to surmise the entry of hurtful matter into any milk with which the farmer had to do (No. T. F. 41).

CONCEALMENT OF INFECTIOUS DISEASE.

The concealment of infectious disease on dairy farm premises and the like has played its part in the causation of disease through the agency of milk. At Sunderland in 1882, in connection with an outbreak of scarlatina (No. S. 5), the illness at the dairy in question was only accidentally discovered, it not having been reported. At a milk shop in Hull (No. S. 7) a child was ill of scarlatina three weeks before knowledge of the case came to the health authorities, and no steps had in the interval been taken to guard the milk from chance of infection. And these are but instances taken from the list of epidemics summarised.

UNNOTIFIED INFECTIOUS DISEASE.

Near akin to concealment of disease is the subject of non-notification. Typhoid fever of a fatal character in the person of a farmer, and of a non-fatal sort in the person of his son, was not reported at a farm implicated in the outbreak of that disease in Mid-Warwickshire in 1883, reported on by Dr. Wilson (No. T. F. 13). At Plymouth, when an outbreak of typhoid fever occurred there in 1892 (No. T. F. 29), the Infectious Disease (Notification) Act of 1889 was not in force. And it is this all-important matter of non-notification which has in the past had much to do with the uninterrupted progress of many milk caused epidemics, the health body having been kept in ignorance of the fact of disease being in their midst unchecked until their attention has been drawn to the circumstance by the data afforded by death registers and other tardily received information.

UNDETECTED INFECTIOUS DISEASE.

Closely allied to the matters just treated of is the discovery of illness in the families of dairymen, farmers, and the like, when milk has been traced to be the medium of dissemination. Thus we see in the instance of an outbreak of scarlatina at Greenock in 1881 (No. S. 2), that there had been cases of that disease recently before in the farmer's family. At Glasgow in 1888 (No. S. 17) there was found to have been ill-

ness of indefinite sort of throat affection in the families of two dairymen, whose businesses were interlaced, such illnesses following on scarlatina in other members of the families. At Grangemont in 1882 (No. T. F. 6) a case of enteric fever was found in the house from which milk was supplied. At Canterbury in 1886 (No. D. 6) the milkman and his family were found to be suffering from sore throat. And at Limekilns in Fifeshire in 1892 (No. D. 14) a patient suffering from diphtheria was ascertained to have been walking about the dairy premises the day following notification of his illness, in direct contact with dairy management. These instances serve to illustrate how great is the danger attending on the occurrence of cases of infectious disease, either unsuspected or carelessly left in households connected with dairying and cognate businesses.

SICK NURSES AS DAIRY WORKERS.

The case of Limekilns leads me to draw attention to two or three instances in which the attendant on the infectious sick was also busy in dairy work. At Wolverhampton (No. S. 1) in 1881 the milkseller was engaged in distributing milk during the illness of her children, whom she nursed through an attack of scarlatina, which disease was spread by the milk thus sold. At Dundee in 1883 (No. S. 9) the milk causing scarlatina in its consumers was stored in a kitchen wherein was laid a boy suffering from the same disease, and whose attendants carried on the dairying business. At Derby in 1884 (No. T. F. 16) the napkins of the initial fever patient at the farm were washed in the farm pump trough, whilst the mother-nurse of the patient was engaged in milking the cows and in washing the milk cans. Here, then, are instances of gross disregard for the common decencies of cleanliness and of the common right of man to secure that his food shall be served to him free from the conditions enticing disease and calculated to foster infection in the very means of life.

STORAGE OF MILK.

The storage of milk has ever been an important matter in the course of inquiry into milkborne epidemics, and instances of neglect in the direction of exposure of milk to deleterious influences in this way have been by no means infrequent. At Shirley Warren, in Hampshire, in 1894 (No. S. 22), it was ascertained, while inquiring into an outbreak of scarlatina traced to milk, that the milk in question was placed without a cover in a penthouse, under the same roof as an adjoining house wherein was a boy suffering from the same disease, he having also access to the penthouse while in a stage of desquamation. At Shelf, in 1882 (No. T. F. 4), the conditions surrounding the stored milk were extremely bad, the milk being open to the absorption of drain air, sewage effluvia, and the emanations from an adjoining manure heap. At Dundee, in 1883 (No. T. F. 11), a boy was found to have been sleeping in a room communicating with the milk shop, while certified to be suffering from "neuralgia," though several members of the dairymen's family were found to have suffered from enteric fever at the same time or thereabout. Very crude were the notions of a farmer selling milk found to be causing typhoid fever at Carlisle in 1886-87 (No. T. F. 20), the milk storeroom being a small pantry between and continuous with a kitchen and yard, the latter containing a slaughter house, cowsheds, and an ashpit privy containing the evacuations of a typhoid fever patient. At Edinburgh, in 1890 (No. T. F. 27), we find milk being passed into cans in a small building aërially and closely connected with a filthy cow byre. Deplorable were the surrounding circumstances affecting the storing of milk in a farm at Shildon, in 1893 (No. T. F. 38), the room used for storage having a window opening on to three uncovered midden privies, on to one of which at least were cast the untreated evacuations of a typhoid fever patient. The room was also open to emanations from a sewer close at hand. These instances suffice to demonstrate the serious state of things existing at our dairy farms and milk shops, a condition of affairs calling for remedy beyond the possibility of recurrence. Milk being a most ready absorbent, it becomes the more important that all deleterious influences that may be in any wise thought of as likely to operate to the danger of the consumers of the milk should be removed. At the same time, of course, I do not lose sight of the fact that occurrence of infectious disease

in aërial relation with milk of a quality to cause disease in its consumers is by no means always the cause of the effect of such milk, but not infrequently only itself the result of ingestion of the milk on the farm or dairy premises. But however this may be, my main contention holds good.

QUANTITY OF INFECTED MILK USED AND AMOUNT OF DISEASE RESULTING.

One matter which has come to be very clearly demonstrated as time has gone on is the relationship existing between amount of milk consumed and the amount and severity of the disease induced by the implicated milk. Indeed, this point has come to be one of the methods by which the certainty of milk as a cause of disease has often been ascertained beyond doubt in well-to-do localities, taking much milk per house; whilst the amount of disease per household has now come to be seen to depend on, first, the number of young children in the home, and secondly, on the quantity of unboiled milk consumed by those children. In Wimbledon and Merton, in 1886-87 (No. S. 11), the scarlatina attacked especially well-to-do people, and was seen to show preference for those persons who partook of most milk, the rateable value of houses and quantity of milk being important factors in determining the amount of disease to be expected. At Upton and Macclesfield, in 1889 (No. S. 18), in the outburst of scarlatina, there was a difference as between 45 and 89 per cent. of households attacked according as one-third or the whole of a pint of milk and upwards was taken, and a difference as between 12 and 50 per cent. of members of those households attacked. At Bush Hill Park, in 1891 (No. S. 21), the incidence of scarlatina was greatest on houses taking most milk, scarlatina attacking chiefly well-to-do households. The matter first came to be clearly defined when Mr. Power conducted his inquiry into milk diphtheria at York Town and Camberley in 1886 (No. D. 7), for there he found that the amount of milk consumed determined the amount of disease, 84 per cent. of better class customers, and only 22 per cent. of poorer customers, of the milk supply being attacked. In his summary of the chief facts of the outbreak, Mr. Power says: "Though uniformly infective on leaving the farm, the milk had a very different effect in causing diphtheria according as it was distributed to one and another class of consumers. This difference of effect of the milk had to do with difference of amount (and related difference of use and difference of conservation) of milk distributed in the two classes. The diphtheria among better class consumers was, as regards amount and fatality, so conspicuous that its relation to the milk service was readily seen; but among poor class consumers, it was so inconspicuous in amount and fatality that the fact of its relation to the milk service might readily have been overlooked. It is altogether doubtful, therefore, whether in the absence of the test of the milk which was furnished by the behaviour of the epidemic among customers of the better class, the ability of this milk service to cause diphtheria would have been detected."

MILK OUTBREAKS OF UNTRACED ORIGIN.

It is not to be supposed that because a particular outbreak of disease attributed to the agency of infected milk has not been traced to the *vera causa* of the infective quality of the milk in question, therefore the theory is untenable. This supposition does not hold good in other phases of disease dissemination, as for example the waterborne diseases, concerning which it has been impossible at times to state with clearness borne out by irrefutable facts what was the precise method of contamination of the water which none the less caused the malady attributed to its agency. As an instance of a milk outbreak of this class I may mention that of Glasgow in 1882 (No. T. F. 7), where the typhoid fever arising in connection with a milk supply was wholly among persons consuming the milk, not one case being found to have been in an individual not using the milk. It was just as well that the disease should have been thus wholly limited to milk drinkers, since no trace was found of the means whereby the infective quality of the milk was induced.

INFECTIVE MILK OPERATING AT A DISTANCE.

There have been not a few instances in which the milk implicated in the spread of infectious disease has caused mis-

chief. It is the custom of procuring milk from a distance which has in time past added to the trouble of tracing the source of the outbreak under investigation, and it is this same custom which is to-day causing no little disturbance in the minds of sanitarians, since it militates against prompt action of needed sort in many directions. The Bush Hill Park outbreak of scarlatina in 1891 (No. S. 21) was caused by milk from a farm in Essex. The typhoid fever outbreak at St. Pancras in 1883 (No. T.F. 10) was traced to milk as a cause, the milk coming from a farm at St. Albans, and causing also fever among consumers in that city. In the case of the 1893 scarlatina epidemic at Hastings, traced to milk (No. S. 27), the milk came from a farm in an adjoining district, and thereby caused trouble by reason of the non-adoption at the moment of the Infectious Disease (Prevention) Act of 1890.

MILK OPERATING IN MULTIPLE DISTRICTS.

Instances are not wanting in which the milk causing disease has been productive of mischief in multiple districts; for example, in the case already named of Bush Hill Park in 1891 (No. S. 21), where the village whence the milk came in Essex was attacked in the two houses using it; and in the Charlton outbreak in 1892 (No. S. 22) no fewer than 7 distinct and even widely separated districts were invaded. Accordingly, given a dairy serving with disease-disseminating milk a few customers in several localities within the jurisdiction of multiple sanitary authorities, and we see the immense premium which is set upon the elucidation of the cause, thus operating widely, and it may be in small proportions only, in the separate districts.

REINVADED SUPPLIES AND TOWNS.

One instance worthy of record is that of one and the same farm giving rise to outbreaks of similar disease on two distinct occasions. The typhoid fever outbreaks at St. Pancras in 1893 (No. T.F. 10), and at St. Albans in 1884 (No. T.F. 15) were caused by milk from the same farm at St. Albans, and in each instance the farm well was declared at fault, this circumstance pointing to the danger attending delay in setting sanitary matters straight, since we must assume that adequate prominence was given to the state of the water supply on the earlier occasion. Not a few of the abstracts relate to the same town on more than one occasion, showing multiple milkborne outbreaks at different times.

THE PROHIBITION OF INFECTED MILK.

One of the most useful and at the same time drastic measures which can be taken with the view of staying the progress of disease traced to the agency of milk is the stopping of the sale of the article by the farmer or retailer in the district affected. In the case of an outbreak of typhoid fever at Dundee in 1883, and traced to milk (No. T. F. 11), the sale of the milk was stopped under the provisions of a local Act, the particular section in question being as follows:

"Dundee Police and Improvement Consolidation Act (1882), Section CCXLIV.—The sheriff may, on a certificate from the medical officer that in his opinion an infectious disease is being spread, or is likely to be spread, throughout the burgh by the sale or delivery of milk from a farmhouse, steading, or other premises, whether within or without the burgh, and after allowing parties an opportunity of being heard, issue an order prohibiting the sale or delivery of such milk within the burgh for such period as may appear to be necessary for the public safety, and such order shall be immediately intimated by the sanitary inspector to the various parties interested in the sale or delivery of such milk, and such order shall be sufficient authority to any officer or constable of the Commissioners to prevent the sale or delivery of such milk within the burgh; and the sheriff may by subsequent order extend or limit the period of such prohibition, and every person in the knowledge of such order selling or delivering such milk within the burgh during the period specified in the original or any subsequent order shall be liable to a penalty not exceeding forty shillings."

At Edinburgh in 1890 (No. T.F. 27) the stoppage of the sale of milk was effected also under the provisions of a local Act, the clause being as follows: Clause 211 of the "Edinburgh Municipal and Police Act, 1879."—"When it shall be certified by the medical officer of health to the chief constable that milk is being brought within the burgh from any farmhouse, dairy, or other place beyond the burgh in which any person is ill of any infectious or contagious disease before mentioned, and that the said milk is being sold or offered for sale in any shop or premises within the burgh, or distributed therein from carts or otherwise, the prosecutor shall apply to the judge of police for an order to prohibit the sale of milk so brought from and after the intimation of such an order until the person affected has been removed or shall have recovered from such illness, the premises been disinfected, and the bedding and clothing have been destroyed or thoroughly disinfected, and it is certified by the medical officer of health that the said premises are free from infection, and that the sale of milk from such place may be safely resumed."

Dr. Littlejohn tells us in his report on the 1890 outbreak that the clause works very slowly, as it is a matter of delay to get the necessary legal power to act, the earlier action in this instance having taken the line of warning and expostulation, so that the milk was practically kept back from sale in the city two days prior to the obtaining of the needed order. Moreover, it will be noticed that even so action depends on the occurrence of infectious disease in the human subject on the dairy premises, so that no illness of the milch cows, even though it were such as to be causing infective quality of the milk, would suffice to secure the order for stoppage of the milk. And, again, it will be seen that the stoppage of sale has effect only in the city, as in the Dundee case, thus allowing the farmer to proceed as he chooses with the implicated milk in other quarters. In the circumstances of an outbreak of typhoid fever at Kelso, in Scotland, during 1893 (No. T.F. 35), where the power needed to stop the sale of the implicated milk did not exist, the sanitary authority took drastic measures. To quote from the report of Dr. Oliver, the county medical officer of health, "The whole of the milk and cream found upon the premises was destroyed, and arrangements were made for destroying the milk twice daily immediately upon the cows being milked. This arrangement was duly carried out under the supervision of the police up to the time when the cows were disposed of. Full compensation was made to the dairyman—one-half payable by the district committee and one half by the burgh authority."

These are but samples of the action taken to stop milk supplies. At times it has not been necessary to resort to legal action, the farmer or dairyman taking upon himself to destroy the milk, recognising it as that which has caused disease and even death, and only too desirous of proceeding in the cause of public health; but such magnanimity has been infrequent. One point which has struck me in connection with all present legislation as to stoppage of milk services on account of infectious disease dissemination is the ridiculously small amount of the fine to be inflicted when the order is not obeyed. I am further of opinion that power is needed to stop absolutely and for all places the sale of milk found to be causing disease anywhere. It seems absurd that milk deemed to be capable of spreading disease in one locality should be permitted to be sold in another. The people of B. are assuredly no less prone to disease than those of A.

"ROPY" MILK.

It has been interesting, while collating the facts given in the abstracts of milk outbreaks since 1881, to notice how new features and factors have been brought out and added to our knowledge of milkborne diseases. One of the points to which my notice has thus been called is the condition of milk known as "ropy." In his very able report on an outbreak of diphtheria at Hendon in January, 1883 (No. D. 2), Mr. Power referred especially to this ropiness of the implicated milk, which condition had been early noticed by Dr. Cameron, the medical officer of health, and also by the farmer, whose attempts to discover which of his cows was giving the ropy milk failed even a few hours after the last distribution from his dairy of milk in a state of ropiness.

The evidence went far to convince Mr. Power that ropiness of milk may tend to disappear rapidly, or that it may not ensue until the milk has stood for some time, whilst also the ropy quality may be one of growth from small beginning, ropiness of large degree being the multiplied result of a small quantity of ropy milk added to some larger quantity of normal character. Mr. Power significantly chronicled a growing misgiving to the effect that ailments of animals so trivial as to be disregarded or even unnoticed by people about them might have larger concern with occurrence of specific disease in the human subject than had theretofore been thought likely. Looking to-day at the position we have reached in this direction, we can see how well defined were the "misgivings" which Mr. Power so guardedly promulgated on a public hardly sufficiently educated to accept the notions with which he was even thus early imbued. We see evidence of ropy milk playing its part in the scarlatina outbreak at Charlton in 1892 (No. S. 22); and at Warminster, where a milkborne outbreak of typhoid fever occurred in 1895 (No. T. F. 47), persons using the implicated milk testified to its "ropy" and putrid state on two or three occasions. Whatever may be thought of the matter, it is certain that a stringy or ropy condition of milk has had its share in the potency of milk to produce disease.

MILK OF NEWLY CALVED COWS.

I come now to a very important discovery of modern times, a discovery that is of not more than fifteen years' standing, and having a direct bearing on what has just gone before. I refer to the factor which the calving of cows has been found to be in the causation of disease by use of their milk shortly after the physiological process of calving. An extensive outburst of a mild sort of scarlatina in the north of London, investigated by Mr. Power for the Local Government Board in 1882 (No. S. 3), seemed by the inquirer to arise from some condition of the milk of a cow recently calved. This animal had lost portions of her coat, whilst her buttocks and posterior udder, when seen by Mr. Power in the month following the outburst, were fouled and stained by excremental matter, and perhaps, he thinks, by vaginal discharge as well. The milk was distributed to several sanitary areas in London, and the story of special incidence on consumers of the milk of the scarlatina was the same from all. The malady attacked persons who partook of the milk whether at the terminus or from shops. Dr. Parsons, in connection with the outbreak of milk-scarlatina which he investigated at Upton and Macclesfield in 1889 (No. S. 18), dwells on the circumstance of a recently calved cow having been added to the animals from which milk was being drawn at the farm implicated, and he says (and his remarks are extremely interesting) in drawing his deductions as to the cause of the disease:

"Of the two cows bought by Mr. V. on or about January 14th, one had calved about four days before. Its calf was not with it. Its milk was at once added to the general stock. The other cow calved on January 20th. I am informed by Mr. V., junior, that the calving and cleansing were perfectly natural. The milk of a newly-calved cow, called by dairymen "beastings," is not at once mixed with the general stock, as it is albuminous and sometimes tinged with blood; it coagulates with heat, and is sometimes used for making puddings and custards. After six milkings it is added to the other milk; but before doing so Mr. V. takes the precaution to boil some to make sure that it is no longer coagulable by heat. In the case of the cow which calved on January 20th the "beastings" were not bloody, and presented no peculiar appearance. Only one customer had any, the calf being allowed to suck. The milk of the newly-calved cow was first distributed with the general supply on the evening of January 23rd—a date which accords sufficiently well with the first outbreak of fever. There is therefore strong ground for suspicion that there was something in the state of this cow that gave the milk its infective quality. On examining the cow on February 11th I found no scabs or sores on the udder or teats. The cow had a few bare patches, $1\frac{1}{2}$ to 2 inches in diameter, on the rump on either side, around which the skin was scurfy, and the hair could be pulled out. No vesicular eruption on the skin was found. The temperature (February 11th) was 101° F., the normal temperature of the cow being stated

to range between 100° and 102° F. On one occasion a yellowish slimy vaginal discharge was noticed. The calf was healthy and thriving; it had not, after the first three days, been fed specially on its mother's milk. The other cow, bought on or about January 14th, had many bare patches on the neck, and a few on the back and rump, on one of which was a thin scab (attributed to scratching). Its temperature on February 11th was 101.4° F. Several of the other cows, especially of those in the same shed with the above, had similar bare patches on the neck, rump, and root of tail; none had any sores or scabs on the udder or teats."

He says, further, of the second cow that was in question: "On the occurrence of fresh cases of illness among his customers coming to his knowledge, Mr. V., on March 13th, left off adding the milk of the cow which calved on January 20th to the general stock, and it has since then been given to the calf. In the early part of March some pimples or vesicles developed on one of the teats of this cow; and at the time that her milk was rejected scabs had formed on these. On my visit on March 25th, there was a thin adherent scab, about the size of a sixpence, dark in the centre and light at the edge, near the lower part of one teat. The teat felt sticky when grasped, and the milk came less readily from it than from the others, having had to be drawn off that morning with a quill. The cow had lost flesh. The calf was healthy."

These instances have been both of them culled from reports of experts attached to the Local Government Board, but I state one now from the pen of Dr. Bostock Hill, of Sutton Coldfield, where was a milk-scarlatina outbreak in 1891 (No. S. 20), and as to which he tells us that the outbreak was of the nature of explosions coinciding with periods of ulceration and eruptive conditions of a newly-calved cow. This cow was much emaciated, with some indication of recent ulceration of teats, whilst later she had an ulcer on one teat and an eruption on the udder. A second cow presented similar indications. Reverting again to Mr. Power's investigations in the matter of milk outbreaks, I may call attention to his inquiry at York Town and Camberley, in 1886 (No. D. 7), where he regarded diphtheria as caused by milk from two newly-calved cows, the milk from which had been added to the business at a time coinciding with the manifestation of the malady. Dr. Anderson, of Dundee, regards the eruption of teats in a newly-calved cow as the *vera causa* of infective quality of milk causing typhoid fever in the town in 1889 (No. T. F. 24). Thus we are face to face with a fact, and it is the more important when we remember that the condition attaching to newly-calved cows is not one which has been deemed of any significance by veterinary inspectors. Indeed, one may be pardoned for saying that the subject of milkborne disease is furnishing history of long struggles by medical as opposed to veterinary opinion. But this struggle has been harder in the matter of eruptive diseases of cows than on any other point, and the victory has been certainly with the medical experts.

ERUPTIVE DISEASES OF MILCH COWS.

Eruptive conditions of teats and udders of milch cows have received some amount of attention in regard of their supposed ability to cause infective quality of the milk secreted by the animals affected. The now well-known "Hendon" disease of the teats and udders is the first case that I will recall (No. S. 10), Mr. Power being the investigator, whose theory startled the medical and veterinary world, he stating that he looked to the condition of certain milch cows, which manifested outwardly an eruption of teats and udders, as the *vera causa* of scarlatina in consumers of their milk. This condition was one communicable from cow to cow. The special incidences of the disease were seen to be governed by the movements of certain cows in the sheds whence the milk came, Mr. Power proceeding to show by a process of very careful exclusion that the ordinarily conceived methods of spread of the disease by milk were not to be thought of in this instance. But before going on to show what it is that was principally demonstrated it will be well for us to see what was the state of the farm which was in question, and for this purpose to quote from the report:

"The farm was found to have had especial pains taken to render it, as the phrase is, sanitarily perfect. At the instance of one of the London retailers with whom the farmer had

dealings, the place had for several years been the subject of special supervision by the medical officer of health of the district, my coadjutor in this inquiry, Dr. Cameron. He had seen that the West Middlesex Company's water was laid on to the farmhouse, to the dairy, and each of the several cowsheds; he had seen specially to the wholesomeness, as regards drainage, cleanliness, ventilation, and the like, of the house, the farmyard, the cowsheds, and the dairy; securing for the last all needful appliances for effectual cleansing of dairy utensils by hot water or steam; and, month by month, he had inspected the farm premises with reference to these and similar details, for the express purpose of safeguarding the milk against contamination of any detectable kind. Further, under the same arrangement, Dr. Cameron had specially attended to the health conditions of those employed about the farm and their children, with a view to early detection of any malady among them that might by chance injuriously affect the milk with which they had to do. He had even undertaken to observe and to report to the London retailer, by whom his services were retained, on any occurrences of infectious illness in the neighbourhood of the farm, even though it did not directly affect the families of people employed there. The farmer too who had consented to the exercise of this supervision over his doings, had attended to every suggestion made to him, and had taken every precaution to secure his farm and his milk against any known sanitary fault or misadventure. He had a separate shed for any sick animal, and a separate shed for the observation of newly arrived animals."

It were indeed well could every dairy farm have the same sanitary attention as that paid to this particular farm, and which, even with all its advantages, was not to escape the stigma of having caused by its stock malignant disease in consumers of its produce. Proceeding very carefully and in great detail to solve the complex problem set by the manner of distribution of scarlatina in London, Mr. Power was enabled to see that the specialities of the disease distribution had causal connection with new conditions at the farm, these conditions being the addition of cows to the milking sheds. Moreover, the specialities of distribution of the milk of these newly arrived cows were parallel with such distribution of scarlatina. Further, the peculiarities of time distribution of the scarlatina were parallel to peculiarities of time distribution of the milk of these cows. "In short," he adds at one stage of his report, "what had been seen to be a succession of probabilities if the scarlatina in London districts were indeed the outcome of the milk distributed from the Hendon farm was now established as a succession of facts. We had thus reached the point of excluding external scarlatina, of associating the importation of particular cows into the Hendon farm with presence of scarlatina in London districts, and of connecting by a series of parallel events the milk furnished by those cows and by related cows, with the peculiarities of scarlatina prevalence among consumers of the Hendon farmer's milk. Under these circumstances it was not judged necessary to go beyond the Hendon farm, and to inquire at the two other farms that also sent milk into the London districts of South Marylebone, Hampstead, and St. Pancras, in search of the cause of scarlatina in those districts. Henceforward, until anything to the contrary should appear, an influence, competent to produce scarlatina among the consumers of the milk, was held to have operated from those cows which were received into the Hendon farm on November 15th, and the further concern of the inquiry was with the nature of such influence."

I do not propose here to describe the later portions of Mr. Power's able report, further than to quote one more section of an accompanying paper, which shows in brief the grounds which he had for his conclusions, the quotation this time being from the pen of the late Sir George Buchanan in his introductory report on the matter, in which he has summed up in masterly style all the pertinent facts of the case, and in which, in speaking of Dr. Klein's laboratory studies with material from the teats and udders of the implicated cows, he states: "Dr. Klein records his early investigations into the intimate nature of the ailment present among the cows. In its own province Dr. Klein's report is as important and as interesting as Mr. Power's, and its more immediate significance lies in the complete harmony between the conclusions obtained from Mr. Power's etiological

researches and the inferences as to communicability and other characters of the Hendon cow disease that follow from pathological inquiry. By the inoculation into calves, either directly of the discharges from cow ulcers or indirectly of subcultures of those discharges artificially prepared, Dr. Klein has succeeded in producing, now local, now general, disease in the calf; disease having unmistakable affinities, under some conditions with the Hendon cow disease, under other conditions with scarlatina in the human subject; on the one hand, ulcers on the skin of the calf anatomically identical with the ulcers on the teats of milch cows; on the other hand, general disease in the calf, at first of inconspicuous nature, but passing on to serious changes in the internal organs, more particularly in the kidneys of the calf; the more characteristic of these changes being anatomically identical with those resulting in the human subject from the operation of the scarlatina poison."

Under date of August, 1887, Sir George Buchanan was able to write as follows, and the summary of facts is significant and instructive:

"By Dr. Klein's researches, together with the evidence as to scarlatina collected by Mr. Power and reported by me last year, we are now in a position to state as follows concerning the disease producible by this micrococcus in bovine animals and in man:

"(1) The disease in man and in the cow alike is characterised by closely similar anatomical features.

"(2) From the diseased tissues and organs of man and cow alike the same micrococcus can be separated, and artificial subcultures be made from it.

"(3) These subcultures, no matter whether established from man or cow, have the property, when inoculated into calves, of producing in them every manifestation of the Hendon disease, except sores on the teats and udders, no doubt for the reason that the milk apparatus is not yet developed in calves.

"(4) But—and this I learn from Dr. Klein's later observations while this report is in preparation—the subcultures made from human scarlatina and inoculated into recently calved cows can produce in those cows, along with other manifestations of the Hendon disease, the characteristic ulcers on the teats—ulcers identical in character with those observed at the Hendon farm.

"(5) The subcultures, established either from the human or the cow disease, have an identical property of producing in various rodents a disease similar in its pathological manifestations to the Hendon disease of cows and to scarlatina in the human subject.

"(6) Calves fed on subcultures established from human scarlatina obtain the Hendon disease.

"(7) Children fed on milk from cows suffering under the Hendon disease obtain scarlatina.

"The above combine, I think, to form a mass of evidence to show that the Hendon disease is a form, occurring in the cow, of the very disease that we call scarlatina when it occurs in the human subject."

Exactly twelve months later Sir George Buchanan supplemented the above by saying of Dr. Klein's further researches into the etiology of scarlatina, and more particularly as to the above-mentioned production of ulcers on the teats of newly-calved cows:

"He takes such animals and inoculates them subcutaneously at the root of the ear with the material of scarlatina. Sometimes he has derived his material direct from the human subject, sometimes after it has passed through the system of a calf. From whichever source the material may be derived, its inoculation results in ulcers on the teats of the cows. He finds these ulcers to be among the very earliest evidences of disease in the animal. They occur indifferently, whether the cow is being milked by hand or is suckling her calf. The teat sores show themselves after an incubation period of from four to nine days from the inoculation, and subsequently a more general affection of the skin is found, accompanied by more or less of febrile disturbance, and sometimes by pulmonary symptoms. In the disease thus induced a number of changes are found after death distributed among various organs in the fashion of the changes of an acute specific disease, and exhibiting so much of constancy in their own manifestation as to make the whole of them

characteristic of cow scarlatina; and the *post-mortem* appearances found in animals affected by this disease bear much resemblance in essentials to those found in human subjects dying of scarlatina. As regards the particular phenomena on the skin of animals thus affected, it is interesting to note that the sores on the teats appear to be with difficulty, if at all, transmissible by direct inoculation from the infected animal to man. This circumstance was hardly perhaps to be anticipated, seeing how readily other sore-teat diseases are so communicable, and how readily cow scarlatina at Hendon reproduced itself as human scarlatina in the consumers of milk from infected cows."

The controversy which raged round the circumstances attending this Hendon outbreak must still be fresh in the minds of those who followed the subject, the veterinary world being especially convinced that the theory held by the Medical Department of the Local Government Board was untenable. But events have proved, as in so many other instances, that the views put forward by the Public Health Department of the State were right, and that the only thing to do was to accept with what grace could be found the convincing arguments and solid data which went to uphold the theory as matter of fact. At Wimbledon and Merton in 1887 (No. S. 11), the same investigator, Mr. Power, made inquiry as to scarlatina spread by milk, and here also he found cow conditions almost exactly similar to those in the Hendon case, he having in this, as in that outbreak, the assistance of Dr. Klein in the laboratory work. In inquiring into an outbreak of scarlatina in Norfolk (No. S. 13), Dr. Mallins found a rash on the teats of a cow, and a "humour" all over its body, the rash having the appearance of small red pimples, while the cow at a later stage of the illness desquamated freely. Her milk on standing presented a distinctly greyish colour. At Bush Hill Park, in 1891 (No. S. 21), Dr. Copeman found reason for connecting abraded teats of cows in Essex which furnished the milk, with the spread of the disease, one cow having a vesicular scab, whilst others had boils on their teats. Certainly the outbreak was due to milk, and no fault could be found with the dairy or farm premises, nor could the origin be traced to human agency. But Dr. Klein was unable to demonstrate the streptococcus corresponding with that in the Hendon cow malady. At Glasgow in 1892 (No. S. 24), Drs. Russell and Chalmers made elaborate inquiry into a milkborne outbreak of scarlatina, and found the premises concerned to be in a sanitary point, and indeed in all others, all that could be desired. I could have wished to quote from the report of these inquirers, and from that of Dr. Klein, whose services were requisitioned, but it must suffice that an eruptive disease of an ulcerative character on the teats of the cattle was found, it being styled "vesicular," "quasi-pustular" in form, and "covered with a blackened centre." The malady was communicable from cow to cow and shed to shed, and milking apparently formed sores on the hands of milkers, who accidentally discovered the diseased condition of the teats owing to the restive state of the cows under the operation of milking.

Dr. Klein found the disease of the cows to be in some points identical with the "Hendon" and "Camberwell" disease. As to the latter, Sir George Buchanan in 1889 wrote that in the preceding year Dr. Klein had under observation a cow from a dairy in Camberwell where scarlatina had appeared among customers of the dairy, and this cow was found to exhibit the same disease as those formerly recorded as prevailing at Hendon, the disease, namely, which we now confidently recognise as scarlatina in the cow. Turning now to diphtheria outbreaks in which cow conditions have had concern with the spread, I revert first to the Croydon case of 1890 (No. D. 10), where Dr. Philpot states that the cause of the disease was an eruptive state of the teats of the cows, found by Dr. Klein to be of a sort similar to other diphtheria outbreaks traced to cow conditions. Dr. Thursfield in 1891 found in connection with an outbreak of the disease in Worcestershire (No. D. 11), that the cause was a pustular disease of the teats of cows, which pustules burst in the act of milking. The cows were in a febrile state. And to bring my account of these types to a close, I may fittingly refer to the outbreak of diphtheria at Glasgow in 1892 (No. D. 13), investigated by Dr. Russell, who tells us that nearly all of a herd of over fifty cows suffered from teat eruptions, leading

to ulcers which yielded faintly coloured fluid. At times all teats were affected, but two varieties of eruption were in question as shown by experiment, one being true vaccinia, the other a non-vesicular eruption of a specific character, like that known as the "Camberwell" cow malady. Milkers suffered from sore hands. The business at both dairy and farm was carried out with scrupulous care and attention, no insanitary conditions being found. As regards the "vaccinia" eruption, I may mention that in 1888 a cow from Alderley, in Gloucestershire, was, on the testimony of Dr. Klein, shown, by inoculations of calves and ultimately of children, to have the characters of that "variola vaccinae" which Jenner discovered in the same county last century, and which he put to the purpose of protecting against small-pox. These then are some of the facts recorded in my abstract as to the relation of teat and udder diseases of milch cows to disease in the human subject following upon ingestion of milk yielded by cows affected in the manner related. The point is deserving of lengthy discussion, but it must suffice for the general purposes of this report that I have laid bare what has here been stated on this topic.

WASHING OF MILK CANS.

I now come to a brief discussion of some phases of milkborne disease as depicted by some of the outbreaks of milk-typhoid fever that I have abstracts of in my appended summary. And, first, I would refer to cases of can washing that seem to have had in them the element of danger to the milk which the cans were destined to contain. The opening abstract is one which demonstrates my point, since the milk cans of a farm implicated in a fever outbreak at Leicester Infirmary in 1882 (No. T. F. 1) were washed with the water of a well situate near the end of a house drain, and polluted by the overflowings of a leaky cesspool, analysis showing the presence of sewage in the contained water. In connection with the serious epidemic of typhoid fever in St. Pancras in 1883 (No. T. F. 10), and traced to milk from a farm in the country, the cans were washed in the water of a well located near a cesspool. A foul watercourse flowing down a ditch was in the case of the outbreak at Aberdeen in 1883 (No. T. F. 12), used for "dairying purposes," whatever that may mean. Probably the meaning is identical with much that passes under the term "washing of dairying utensils." And in the very next instance which I mention, that of an outbreak of milkborne fever in Mid-Warwickshire in 1883 (No. T. F. 13), the cans were washed, even if the milk was not also diluted, with water from a well contiguous to a leaky cesspool, evidence being forthcoming to demonstrate specific contamination of the well water prior to such dairying procedures. In relation with an outbreak at Dundee in 1892 (No. T. F. 32), the cans were washed in the water of a draw well, although the public water supply was laid on to a tap in the cowshed. And, lastly, in connection with an outbreak at Plumstead in 1895 (No. T. F. 44), the use of tank water wherein were found bacteria resembling those in the milk was denied. But, however this may have been, I have referred to a series sufficiently large to have proved, I think, that distinct danger lurks in the custom so widely followed of washing dairy utensils in unwholesome and sometimes grossly-polluted water, even to the point of being specifically contaminated. Not once in the cases referred is the boiling of the water or the scalding of the cans directly mentioned. But as to this phase of the question of milk and disease, as of many others, I shall have occasion to speak at a later stage of this report.

MILK COOLING PROCESSES.

Closely allied to this matter of can washing is that of milk cooling. I mention two cases as sufficing. First, that of Louisville, Kentucky, investigated by Drs. Bailey and Tuley (No. T. F. 34), in 1893, who stated that the cans after being washed were cooled by water which was left in them in small quantity, and which water was found to contain the Eberth bacillus of typhoid fever. In the relation of the facts connected with an outbreak of fever in Lambeth in 1894 (No. T. F. 40), Dr. Verdon tells of a curious accident whereby water found its way into the milk supply of an implicated farm. His story on this point is well worth quoting:

"The introduction of water into milk, coming from the proprietary farm, is accounted for by the condition of the refrigerator in use at that place. Pinholes, or perforations, have been discovered since the adulteration took place in the gridiron or coil, a section of the apparatus through which a stream of cold water constantly runs when the process of cooling is going on. Coils in general favour with dairymen are made of metal rolled into exceedingly thin plates in order that the pipe wall should interpose between the warm milk and cold water, a medium that interferes in the least possible degree with thermic interchange. The delicate metal, however, is liable to perforation at any time in the ordinary exigencies of usage; and when puncture takes place, milk passing over the coil becomes diluted by water corresponding in amount with the volume of leakage from the enclosed current. Such an accident appears to have happened in connection with the refrigerator in use at the proprietary farm; at least, the artificer who was summoned to examine it declared to the existence of three extraneous apertures. How long watering had been going on, and to what extent dilution had reached through this subtle agency it is impossible to say, but added water in small quantity had been found in milk distributed by Dairy B. a few weeks before, and it is not unlikely that the same leakage was in operation then. The expediency of exercising a close supervision over the produce of dairies where refrigerators are at work is the moral of this discovery."

Dr. Verdon's warning is not without its significance, and points to the need for closeness of supervision of all matters pertaining to dairying.

MILK IN ICE-CREAMS.

We have heard much of late with regard to the dangers of eating ice cream from the barrows of street vendors of this commodity, and I refer to a case in which the ingestion of ice-cream of this description was followed by typhoid fever in several districts of London, the facts having been very patiently worked out by Dr. George Turner (No. T. F. 33) in 1892. The ice-cream was made amid gross insanitary conditions. The precise mode of entry of the specific poison of the fever could not be definitely traced.

CREAMERIES.

The relation of creameries to milkborne typhoid fever I now proceed to show by two or three references. At Bandon, in Ireland, in 1893 (No. T. F. 39), the separated milk from a creamery caused typhoid in drinkers, the prime cause of infection of the milk being a case of typhoid fever at one of the farms supplying the creamery. The nurse of the fever patient was also the milker, and in this way the milk doubtless became infected. The facts connecting the separated milk and the distribution of the disease are most detailed and convincing. Very curious are the facts connected with an outbreak of fever in the Irish dispensary district of Rahan in 1895 (No. T. F. 45), where milk from a creamery caused fever, the milk coming from many farms and for a distance of many miles round. The separated milk sent out from the creamery is much used in the making of bread by the peasantry. The inside of the bread is not, it is held, sufficiently subjected to heat to render it safe eating if the milk used be infected by the poison of typhoid fever. On the subject of cream and skim milk, I cannot do better than quote from Mr. Power's report on the diphtheria outbreak at York Town and Camberley of 1886 (No. D. 7):

"*Cream.*—Much attention was given to the use of cream, an element of milk essentially subject to storage. It did not appear, however, that cream as such had been very infective. Households habitually taking or 'setting' cream, some 17 in number, were, it is true, heavily smitten by diphtheria; but they were almost without exception households consuming much milk, and they suffered mainly in the persons of their children, very few indeed of whom had, it was found, partaken of cream. As a matter of fact, in these households adults by whom the cream was consumed did not suffer more diphtheria than adults in other 10 households consuming quite as much milk but using no cream at all. But if cream is not to be convicted of any special influence in determining attack, skim milk is by no means free from suspicion, notwithstanding a general belief on the part of mistresses of

households that it had been used mainly for cooking purposes. In 11 households in which skim milk had been consumed the incidence of diphtheria on both adults and children was heavier than in any other group of households of similar size. The figures here dealt with are perhaps (especially as regards children) too few to warrant any decided inference; but it deserves notice that in these 11 households there was no special incidence of diphtheria on adult cream consumers, and that the few persons known to have consumed uncooked skim milk suffered very heavily in proportion to their number."

An instance worthy of particular record in which cream had to do with disease in consumers of the product of infected milk is that of Lancing College in July, 1885 (No. T. F. 19), an instance in which the cream was used by boys from the College and others on the cricket field.

POLLUTED WATER SUPPLIES.

The last point on which I touch in the way of emphasising the lessons to be learned from the appended summaries is that of water supplies in relationship with infective milk. In former years, that is, before the seventies, it was generally taken for granted that if milk was causing disease in its consumers, the origin of the infective quality of the milk must be sought for in man, and if not in man, then if typhoid fever were present the water supply must of necessity be thought of as polluted by the specific poison of the fever. The subject of water supply is to-day just as important as ever. With all our boasted advance in matters sanitary, we still drink milk which has been subjected to pollution which is of the filthiest. I have already referred to the outbreak of typhoid fever in the Leicester Infirmary in 1882, in connection with the washing of milk cans in polluted water. The supply of the farm in question (No. T. F. 1), was from a well located near the end of a house drain, and near also an overflowing and leaky cesspool. The farm supplying milk in the Exeter typhoid fever outbreak in 1883 (No. T. F. 9) had its water supply from a well into which a large cesspool overflowed. In connection with an outbreak of typhoid fever at Clapham in 1882 (No. T. F. 3), there were two farms implicated, and at each the water supply was subject to contamination. At one the well was so located that it was in danger of pollution by a brook into which the population of an adjoining village poured their sewage. Cattle drank of the brook. Analysis showed the well contents to be polluted. At the other farm the well was underneath the farm premises, liable to surface or sewage drainage. The outbreak at Lancing College in 1886 (No. T. F. 19), led to discovery of the farm well being dry steined, and near and lower than a drain, while the main sewer of Shoreham ran near the well, which showed traces of sewage pollution. At Edinburgh in 1890 (No. T. F. 27), the farm sending the infective milk to the city was furnished with a well so situated that it must needs receive the surface water from farm, cow byres, piggeries, and a dung heap; while the field surrounding it was manured with excrement. At Torquay, in 1892 (No. T. F. 30), the well implicated was in a confined back yard, and analysis of its contents revealed pollution. And so I might go on naming instances in which the water supply has been condemned as bad, polluted, and even found to be notoriously of bad quality. And so I am forced to the conclusion that the matter of water supplies to our farms and dairies is of pressing urgency still.

SUMMARY.

Thus far, and in very brief fashion, I have set out some of the chief points which are seen to arise on looking over my abstract of milkborne epidemics and outbreaks. The story as related is sufficiently sad and deplorable. It is one that reflects little credit on our boasted sanitary advancement. I am bound and ready to admit that much of the disease traced to the agency of milk has been caused by reason of cow conditions that have in the past been too little understood, and that to a corresponding amount the credit of our country has been saved from the charge of carelessness about disease-disseminating conditions. But when this has been said there remains still very much in the past that throws a strong light on the dark side of English sanitation in relation to milk supplies. We must not forget that in milk we have a staple article of food for many thousands, and that to children and to invalids it is a matter of great moment that

our milk services shall be free from any quality likely to prove injurious to consumers of this farm produce. We already know to our cost that we are frequently, for example, called upon to purchase as milk that which is in fair proportion only the contents of our public water mains, or indeed the contents of some polluted farmhouse well or adjacent ditch. Where milk as an article of diet is prescribed in a medicinal sense it is, to say the very least, hard that it should prove to be the source of disease and even of death. To be killed by professed remedies is a bitter irony of fate. But the fact remains that, treat it how we may, there is death in the milk pail and also in the milk, the one source being too often the fault of man, and the other the result of disease in the milch cow. The whole subject of milk supply is one of vast import in whatever light we look at it, and is none the less so by reason of the proven capability of milch cows to give to the milk which they secrete a quality of infectiveness which carries disease and death in its train.

These things being so beyond the region of dispute, the question arises, What is to be done with the view of safeguarding ourselves against recurrence of the evils attending our milk trade?

SUGGESTED REMEDIAL MEASURES.

THE further question presents itself, namely, Is there any means whereby the matter can be placed generally on a basis of practical safety to the public?

BOILING OF MILK.

There is such a means, and one that is practicable of being carried into effect by all, and that is the simple plan of boiling all milk received into our houses. The practice of boiling all milk is daily becoming more general. Not that it is even to-day by any means "general" in the ordinary significance of that term. Not at all, but it is growing by degrees to the dimensions of a custom in particular circles. Thus it is done by many medical men, and is advocated by medical practitioners. Many persons would not dream of having on their tables either water or milk that had not been submitted to a boiling temperature. The one thing that militates against the more wide adoption of this simple remedy for the evils attending much of our milk is only the trouble involved. There is little else that can be inveighed against it. True, that some people say that they do not care for the taste of milk that has been boiled, but we venture to think that most people tasting milk that has been boiled in ignorance of the process having been gone through would find little fault with the food thus treated.

Accordingly, I would first and very strongly urge upon all persons the prime necessity of boiling all milk immediately on receiving it into their houses, and seeing that this measure is carried out with a regularity and thoroughness that will permit of no doubt of its fulfilment. It is a matter which should be insisted upon with great earnestness, and enjoined on all cooks and domestics, and insisted on in all cookery schools with untiring persistency. The omission of the precaution on one day or single occasion may, as it has done in the past, be to court disaster and death in the home.

BOILING OF MILK DOES NOT CONFER ABSOLUTION ON THE VENDOR.

But the great desirability of boiling milk thus does not put aside the necessity for having all our dairy farms and cowsheds and milk shops in the best of sanitary conditions. By no means. A householder expects, and has a right to expect, that the milk delivered to his door is pure and from premises fitted to secure its continued purity so far as sanitary excellence can secure it. He has a right to expect that all reasonable care has been taken to ensure purity of water used in dairying operations, and that no water, however free from chance of pollution, has been added to the milk or allowed to remain in cans and pails after washing. He has a right to expect that the housing of the cattle, and the food and fresh air allowed them, as well as the cubic capacity of their stalls and breathing space, are such as to lead to no low or bad quality of the milk supplied. He has a right to expect that the condition of the cows is such that no harm

can accrue by reason of any state of health of the cattle such as has been in the past proved to determine deleterious quality and even dangerous quality of their milk. He has a right to expect that such supervision is exercised over dairy farms and milk shops as will ensure the practical impossibility of disease or insanitary conditions existing on premises whence the milk comes. In short a householder procuring milk has an undoubted right to expect that his health in all its bearings has been safeguarded in every possible way that prudence can suggest and experience has shown to be essential.

So, much as I urge the boiling of milk, let it be distinctly understood that I do so as an additional safeguard, and not as in any way absolving anyone connected with the milk business from the adoption of each and every precautionary measure found to be necessary to the production of pure and wholesome milk.

WATER SUPPLY.

Now among the many matters which my abstract brings to light as standing in need of improvement, that of water supply is of as much importance as any. The state of water sources and supplies in the case of too many of our farms is deplorable in the extreme. I need not enlarge on this point, since former pages demonstrate the fact sufficiently. What I would here insist upon is that all supplies should be of unquestionable purity. The law as it at present stands is sufficiently powerful to enable all sanitary authorities who so desire to secure the closure of all wells that are known to be polluted, and if this were not so the authority should, in my opinion, be in a position of having no option but to refuse to register a farm or other premises for the production and sale of milk until a water supply had been provided of a nature to satisfy the authority of its purity and safety against contamination and pollution of all sorts.

Speaking generally, this matter of water supply to our dairy farms and retail premises connected with the milk trade is discouraging, inasmuch as, notwithstanding that much has been written and said as to the danger attending the use of water in relation with milk which has in any way been subject to contamination, conditions have been found to prevail in so many instances of milkborne infection with a persistency that is almost past comprehension. The essentials of cleanliness and reasonable care have been lacking, and it is against wilful neglect and ignorant procedure as regards water supply that we to-day have to wage war. It is not as though the matter of proper water supplies to our farms is one that, while it operated for harm years ago, is to-day no longer in evidence, but it is a fact that our condition in this respect is now as bad, or nearly so, as when I reported on the whole subject of milk in relation to disease 15 years back. My recommendations at that time as to this matter ran as follows, and for convenience I reproduce them in italic characters:

The water supply of the farm should be derived from an unpolluted source, and care should be taken to preserve its purity at all stages of its use.

The water supply should be easy of access, and should be sufficient in quantity for the purposes of the dairy as well as wholesome in quality. There should be conveniences also for supplying a sufficient quantity of hot water for scalding and washing the utensils.

I note that in a model code of regulations under the Dairies, Cowsheds, and Milkshops Order of 1885 the following clauses are inserted, with a view of securing a water supply for farms and the like which shall be free from all possibility of danger to those using the milk of the farms and dairies of our country:

"Every person following the trade of a cowkeeper or dairyman shall provide for every dairy and cowshed in his occupation an adequate water supply of good quality, and proper for the health and good condition of the cattle therein.

"He shall cause every receptacle in which such water may be placed for the use of any cattle to be emptied and cleansed as often as may be necessary.

"In every case where the water may be stored in a cistern or cisterns, he shall cause such cistern or cisterns to be conveniently placed so as to allow of ready access, and to be properly constructed and covered so as to prevent the fouling of the water."

Surely we have in this regulation sufficient room for safeguarding the public health in so far as water supply is concerned, and it needs only that councils adopt and enforce this salutary regulation to free us from the disgraceful conditions which obtain to-day in so many of our country districts and even towns in connection with the milk industry.

DRAINAGE AND FILTH REMOVAL.

Intimately related to the water supply of dairies is the question of drainage, and the removal of filth and refuse generally. It is essential to the milk business that it should be carried on with scrupulous regard to cleanliness, and hence stringent regulations have been drawn up for the adoption of councils. Milk being such a ready absorbent, it is the more to be guarded against all hurtful influences, such as drain effluvia, the noxious air given off by stored filth, and the gases evolved by living rooms under the same roof as milk store-rooms, as well as from the atmosphere of any cowshed or other house used for the keeping of animals.

HOUSING OF MILCH COWS.

The housing of milch cattle is one of the most important matters connected with the health and milk-producing properties of the cows. And here again regulations have been drawn up for adoption, containing valuable provisions which, if enforced, will do much to safeguard the cattle and their milk from hurtful conditions. The question of cubic space per cow is one of the main subjects which local authorities have to face in this connection, since it is to the supposed interest of cowkeepers to house as many cattle as possible in a cowshed, in ignorance, either wilful or blind, of the ill consequences which are likely to follow upon undue restriction of air space. And so I would enjoin a minimum of 800 cubic feet, as now suggested by the Local Government Board, and would indeed like to see a higher minimum wherever it can be obtained. The condition of some of the cowsheds and the like seen to be connected with the outbreaks referred to in my abstract shows that much more attention should be given to this matter than has hitherto been the case.

MILKING AND GRAZING OF MILCH COWS.

There is a point which I should like to refer to in connection with that of cubic space in cowsheds, and that is the milking of cattle in confined situations. There seems to be but little doubt that we in England house our milch cows under conditions which cannot but be for their physical detriment, and it would seem to follow that we make them too much of milk-producing machines under artificial surroundings. The cattle of some of our colonies, for example, are healthier than our own, and do not therefore suffer to the same extent from maladies which in so many instances end only in the destruction of the cattle; and with the greater amount of freedom and fresh air which our colonial cattle enjoy there comes the greater gain to the cattle dealer and milk vendor. Now it seems to me that what we should aim for is the milking of cattle under more favourable hygienic conditions than such as generally prevail, whereby cattle are milked in stuffy cowhouses and amid all sorts of contaminating surroundings which serve to render the milk liable to pollution at the moment of its withdrawal from the secreting glands of the cow. Why should not all cattle be milked in the open air and away from all possible agencies which can be thought of as likely to affect their milk injuriously? Cleanliness in all its phases is an essential of a well-managed dairy farm, and in this particular, as in all others, it should be aimed at.

In close relation with this latter point, and naturally following on what I have just said, cattle should be confined as little as possible to the oftentimes fetid air of a cowshed, but should be so housed and grazed as to give them all needed fresh air for their bodily development, and with a view to guarding them as much as possible from those classes of malady which spring from close segregation.

PRESENT ENFORCEABLE REGULATIONS.

Before I go further, let me say that among the matters in respect of which district councils can make regulations in relation to the milk trade are the following, namely:

For the inspection of cattle in dairies.

For prescribing and regulating the lighting, ventilation, cleansing, drainage, and water supply of dairies and cowsheds in the occupation of persons following the trade of cowkeepers or dairymen.

For securing the cleanliness of milk stores, milk shops, and of milk vessels used for containing milk for sale by such persons.

For prescribing precautions to be taken by purveyors of milk and persons selling milk by retail against infection or contamination.

On some of these, then, I have already touched, and here I would merely urge upon all sanitary bodies the great desirability of securing for their districts the undoubted advantages which will accrue from the enforcement of regulations having for their object the safeguarding of the public health in a matter so important as the one we are discussing.

INSPECTION OF MILCH CATTLE.

But there is one point which I desire next to touch upon in a special manner, and that is the inspection of cattle in dairies in cases where milk is considered by the medical officer of health to be the cause of disease in the persons of its consumers. I have not yet come across any statute or provision which enacts that a medical officer of health may, as matter of course, on his own initiative, proceed in such circumstances to the inspection of dairy premises. It would seem that he must always be armed with an order of a justice before he can enter on the premises of the farmer whose cattle are yielding the milk which is doing the mischief. And even though armed thus with an order, he cannot proceed further to inspect the cattle in the care of the farmer without and unless a veterinary inspector be present. To my mind there could not well be a more ridiculous enactment than this. We have seen all along that those very conditions of teats and udders of cattle which have been time and again found to be secreting milk that on its withdrawal from their udders has been shown to be in an infective state—that those very conditions have not been recognised by the veterinary world as being of serious import. And even to-day, and notwithstanding all the mass of accumulated evidence against cattle so suffering, no step has been taken to schedule as an "infectious disease" any of the eruptive disorders which are in question, and which have been in the past, as they are now, accountable for much mischief in the direction of disease and mortality; yet it is in company with an inspector of a body which has thus ignored the necessity of recognising these ailments of milch cattle that a medical officer of health can alone inspect the cattle of an implicated dairy. I contend that every medical officer of health should be armed with full power of entry on dairy premises, and of inspection of cattle where milk is regarded by him as causing disease in his district. And in these days of almost universal compulsory notification, he soon learns if any malady is being disseminated by the agency of milk.

PROHIBITION OF INFECTIVE MILK.

Not only so, but to my way of thinking the prohibition of the sale of the implicated milk should be a matter of much greater simplicity than is at present the case. The formalities which have nowadays to be gone through before the prohibition can be effectually brought about militate against any such control of the disease that may be in question as is to be desired for public health reasons. I cannot see why, when a particular milk supply is spreading disease and death in its customers, the private interests of an individual should be so jealously guarded while the community are made to suffer. If a dairyman or farmer has at the end of a day's grace, as will inevitably prove to be the case in 99 cases out of every 100, to stay the sale of the milk produced by his cows, why should not the health body have the power of stopping the sale of the milk forthwith, at the instance of their medical adviser, with the consequence of compensation at the end of the period which is now granted to the dairy proprietor in which to state his case for exemption from the operation of the order for stoppage of sale of the milk if his case be proved? The resulting loss to the rates in respect of squandered milk would be very slight, especially in comparison with the suffering thus prevented, whilst of course the upholding of the order of prohibition would saddle the dairy-

man with the loss. Into the vexed problem of compensation generally I do not here enter; but on the necessity of inspections such as I have hinted at, and on the need of some simple and immediate method of stopping the supply of suspected milk, I must insist.

MILK PROHIBITION SHOULD BE ABSOLUTE.

Another matter to which I wish to draw attention is the absurdity of our present action of stopping the sale of milk by a milk vendor in district A whilst he is permitted to distribute his produce in district B without restraint, until there also the occurrence of disease in association with his milk supply enables the council to take like measures with A to stop the sale, which even then the vendor may carry on in yet another locality. Now, surely common sense dictates the opinion that, milk being considered unsafe food in one district, it should be so considered in all places, and hence any medical officer of health, having placed under the ban a particular supply of milk in his district, should have the power of prohibiting its sale in all localities. At any rate the authorities of districts in which the milk vendor trades should have the option of stopping the sale of the commodity within the area of their jurisdiction.

MILK OF NEWLY-CALVED COWS.

Among the conditions of milch cows which lend themselves to the secretion of milk which has danger for its consumers, we have found calving to be prominent when the mother has been brought into the milking sheds for trade purposes immediately after the process of delivery of her progeny. Hence, some very stringent rule should be laid down as to the time within which the milk of newly-calved cows shall not be distributed for human consumption, and even then not without first testing it as to its coagulable qualities. Inability of boiling to free it from coagulation should condemn the milk as food for man.

ERUPTIVE DISEASES OF MILCH COWS.

As for the eruptive diseases of teats and udders which have been found in conjunction with milk of infective quality, it cannot be too distinctly laid down that all cattle so affected should be at once removed from the operations of the milking shed and placed in quarantine, until they have been declared on medical authority to be in a state in which they can be again safely brought into the dairy business, or, on the other hand, have been destroyed. In this connection, it will be obvious that sustained and frequent inspection of cowsheds is called for in order that the cattle may be kept well under supervision; and the inspection cannot be entrusted to anybody and everybody, but must be made by those whose qualifications fit them for the duty—as, for example, medical men with special training in cow conditions and maladies in relation with disease in the human subject. The matter is one of serious moment and calls for serious attention.

But I feel that I must go still further and insist on the scheduling of these teat and udder eruptions among diseases of animals within the meaning of the Infectious Diseases (Animals) Acts. It may be held that such eruptions cannot find place in the list of diseases for the purposes of those Acts, since the statutes are intended to relate only to diseases of animals in relation with disease in brute creation, though this is not borne out by the maladies now included. But, again, I would refer to the Dairies Supervision Act of 1886 passed by the Parliament of New South Wales, which colony has shown itself ahead of the Mother Country in the matter of such legislation. Under the Act the Governor of the Colony has power to name, add to, or alter the list of diseases to which the statute shall relate, and under the authority thus conferred upon him the Governor, in November of the same year, included among diseases in animals for the purposes of the Act, "Udder inflammations, eruptions, or warts of." And Section x expressly lays down that "it shall not be lawful in any district for any person...to sell or supply any milk which shall have been produced from any diseased animal," such prohibition being one which, if it were in force in our own country, would be for the undoubted benefit of

the public health. And yet we are content to go on disregarding warnings of our State health experts, and allow veterinary authorities to pass as having a clean bill of health cows which are suffering under a malady which has been proved over and over again to be disseminating disease and death to human beings, many of them helpless infants or children whose sustenance to a great extent depends on the quality of the milk which enters so largely into their every-day diet.

LISTS OF MILK CONSUMERS.

A very useful and necessary power has been given to authorities by the above-named Colonial Act with reference to lists of customers of dairymen whose cattle are furnishing milk which has been medically certified to be causing disease in its consumers. In such circumstances the local authority may call upon a dairyman or milk vendor to "furnish forthwith upon demand a full and complete list of all his customers, and to give such assistance to discover the residence of all, or any of them, as the authority making the inquiry may deem necessary." No doubt there are provisions of a similar nature in some local Acts in force in our own country, but I would see such a necessary power conferred on all local health bodies as a matter of course. The usefulness of such a provision to a medical officer of health making inquiry into some intricate and complex prevalence wherewith he is certain that milk has in some way entered will be seen at once. The absence of such power of demanding assistance of this nature from the vendor of the implicated milk has in time past militated much against the elucidation of milk outbreaks, and has no doubt been the means of relegating to the long list of untraced sources of infectious disease occurrences which would with the power to hand have proved easy of settlement.

NOTIFICATION OF DISEASE.

In reference to the question of infectious disease on dairy and farm and milk vendors' premises, I would see a very stringent enforcement of compulsory notification, and heavy penalties inflicted where it can be proved that disease has been concealed, or where infectious illness has been knowingly present in the person of anybody concerned in the business of milking or milk distributing and the like.

PRESENT PENALTIES TOO SMALL.

And dairying operations carried on under conditions which render the milk liable to contamination should be visited with equally heavy penalty. Indeed the matter of penalties needs much reconsideration, since it must needs be that dairymen will often prefer to run the risk of being detected in some underhand business with the chance of a fine rather than hesitate to perform some unscrupulous act, because they find as matter of actual experience that it pays better to run the risk, with the knowledge of only a small fine being inflicted in any case, than lose the added gain that comes from their nefarious practices.

ICE CREAM REGULATION.

I do not here enter into the question of the regulation of the ice cream trade further than to say that I think such regulation as can be applied with any chance of success should be brought about, and that speedily. We dally with these matters far too long, and the evil resulting is allowed to go on uninterruptedly because of the heavy machinery for bringing into operation any needed reforms and the apparent apathy of those charged with the function of moving it.

TUBERCULOSIS.

I am not unmindful of the great gravity of tuberculosis as a disease communicated to man by the milk of cows; but I foresee much difficulty in the way of laying down any suggested measures of prevention as regards the milk of tuberculous cattle in view of the sitting of a Royal Commission on Tuberculosis at the present moment; whilst at the same time I have such confidence in the Commission as now constituted as leads me to expect that much of the legislative and other power needed to efficiently safeguard the public in the matter of its milk supply will follow as a result of the deliberations of that Committee.

CONCLUSION.

I have now finished my task, but very imperfectly I am well aware. Space has not been at my disposal to treat of the whole subject as I could have desired, but I have at least touched on the fringe of the most important of the multiple phases of the milk trade in relation to disease in man, and that must suffice and will suffice if it sets sanitarians thinking more of the matters thus summarily dealt with. The period covered by my report has been one of deep significance, and many discoveries in so far as cow maladies have been concerned in their causal relationship with infectious disease in man. Generally, the most important discovery has been that related to the ability of the cow herself to render infective the milk which she secretes. Human agency in the process of rendering the milk infective is no longer regarded as a *sine qua non* to the acceptance of the milk theory of spread of disease. Then again, the transfer to local health bodies of the powers formerly cast upon local authorities without the

scope of the Public Health Acts, and the Local Government Board in replacement of the Privy Council as the central administrative power have been achieved. Legislation has moved slowly in the right direction of added stringency of regulations in regard to the milk trade, and many local health authorities have obtained powers far in advance of those conferred generally. But it has often happened that advanced town councils have paved the way by means of local legislation for general measures of much moment, and I cannot but hope that very shortly we shall see the best of these local powers brought within the scope of a general measure, which shall also give opportunity for embodying those further necessary additions to our dairy and milk-shop legislation, which by their absence from our statute book hamper so terribly local bodies that are anxious to safeguard the public health on the strength of present admittedly insufficient powers.

ERNEST HART.

ABSTRACT.

I.—DIPHTHERIA AND SORE THROAT.

1.—RUGBY.

Date of Outbreak: March, 1881. *Reporter:* G. Wilson, M.D., M.O.H. *Total Number of Cases:* 100, and others not stated. *Number of Cases amongst Drinkers of Suspected Milk:* All. *Percentage to Total Cases:* 100. *Number of Families supplied by Milkman:* 40. *Number of such Families invaded:* 18. *Percentage:* 45.

Exciting Cause of Outbreak:—Mixture with milk of healthy cattle the produce of a cow suffering from "garget."

Circumstances implicating Milk:—At Rugby School three houses only attacked, with some 30 cases in each, these houses alone being served with the particular milk.

Reference:—BRITISH MEDICAL JOURNAL, vol. ii, 1881, p. 415.

2.—HENDON.

Date of Outbreak: January, 1883. *Reporter:* Mr. W. H. Power, F.R.S., L.G.B. *Total Number of Cases:* 35. *Deaths:* 3. *Number of Cases amongst Drinkers of Suspected Milk:* 30. *Percentage to Total Cases:* 86. *Number of Families supplied by Milkman:* 86. *Number of such Families invaded:* 13. *Percentage:* 15.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived:—Sewer discharges at higher level into a ditch passing within 22 paces from pond used for washing and rinsing purposes in connection with dairying utensils, milk cans etc.

Exciting Cause of Outbreak:—Local health officer regarded contamination of milk as having probably been caused by sewage gaining access to dairy pond by overflow of ditch which is apt to occur. Pond water found to be largely fouled by sewage matter. Mr. Power looks upon the ascertained "ropy" condition of the milk, at a time consistent with his theory, as having given rise to its infective quality, a quality strictly limited in point of time.

Circumstances implicating Milk:—On January 5th, 14 cases of diphtheria came under notice in 6 houses, all of better class, and all taking the one milk supply. In epidemic period, January 1st to 10th, nine tenths of the invaded houses took the particular milk service. Among a few customers served by the same dairy in the adjoining Finchley district nearly a dozen persons in four families suffered from sore throat coincidentally with the Hendon outbreak.

Facts showing Special Incidence of Disease:—Certain families habitually using the milk in a boiled state wholly escaped invasion. Disease especially in evidence where taken in large quantities and used in a raw state.

Reference:—Report to Local Government Board, BRITISH MEDICAL JOURNAL, vol. ii, 1883, p. 124.

3.—"ONE OF THE LONDON SUBURBS."

Date of Outbreak: April, 1883. *Reporter:* Morell Mackenzie, M.D. *Total Number of Cases:* 16. *Deaths:* 5. *Number of Cases amongst Drinkers of Suspected Milk:* All. *Percentage to Total Cases:* 100. *Number of Families invaded:* 9.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived:—Water used for washing can drawn from the ordinary mains through a cistern situate in the cowhouse.

Exciting Cause of Outbreak:—Not traced; but questions arose as to cause arising from (1) direct contamination of milk by human agency; (2) poisoning by impure water; (3) affection of the cows capable of conveying diphtheria; and (4) atmospheric transmission of the poison of diphtheria from pre-existing cases.

Circumstances implicating Milk:—The disease, which had existed in a mild epidemic form for some months, suddenly broke out with great severity, all the cases occurring within 5 days in 9 families. Of these, 6 families derived all their milk from the suspected source, two principally, and one partially. The invaded houses were widely scattered through the district.

Reference:—BRITISH MEDICAL JOURNAL, vol. i, 1883, p. 874.

4.—DEVONPORT.

Date of Outbreak: December, 1883. *Reporter:* Dr. Parsons, L.G.B. *Total Number of Cases:* 31. *Deaths:* 5. *Number of Cases amongst Drinkers of Suspected Milk:* 27. *Percentage to Total Cases:* 87. *Number of Families supplied by Milkman:* 256. *Number of such Families invaded:* 18. *Percentage:* 7.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived:—Farm well 32 yards from dungpit, and 22 from manure heap. Water suspected by medical officer of health, and well closed. Water said to be used only for washing carts. Distributing milkshop had a case of diphtheria next door, the yards to the two houses closed in by high buildings, and air thus stagnated.

Exciting Cause of Outbreak:—Facts consistent with contamination of the milk by infective material of partial amount and of occasional occurrence. Cause of infection may have been some condition of farm or dairy premises, or by milk cans being wiped out with cloths which hung up in the dairy yard, and which might have contracted impurities from the atmosphere.

Circumstances implicating Milk:—Outbreak limited to persons in better class houses, and of good social position. All but two cases (other than the two initial attacks in mid-November) in consumers of the milk of one dairyman; and even of these two, one certainly, and the other probably, had on occasion had milk from the same dairy.

Reference:—Report to Local Government Board, BRITISH MEDICAL JOURNAL, vol. i, 1883, p. 876.

5.—CARDIFF.

Date of Outbreak: 1883. *Reporter:* Dr. Paine, M.O.H. *Deaths:* "Several." *Number of Cases amongst Drinkers of Suspected Milk:* All. *Percentage to Total Cases:* 100.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived:—Well water contained an excessive amount of sewage contamination.

Exciting Cause of Outbreak:—Fatal cases of diphtheria at the farmhouse led to analysis of the well water, and closure of the well for drinking, but not for general purposes. Tin milk vessels rinsed night and morning with well water.

Circumstances implicating Milk:—Some time after partial closure of well fatal cases of diphtheria occurred in the town, all in persons obtaining milk from the infected farm. No fatal cases occurred after total and permanent closure of the well.

Reference:—BRITISH MEDICAL JOURNAL, vol. i, 1883, p. 973.

6.—CANTERBURY.

Date of Outbreak: July 1886. *Reporter:* Dr. Wachter, M.O.H. *Total Number of Cases:* 231. *Number of Families supplied by Milkman:* 196. *Number of such Families invaded:* 116. *Percentage:* 59.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived:—Apparently satisfactory.

Exciting Cause of Outbreak:—Milkman and his family found to be suffering from sore throat; and four calves had been suffering from diarrhoea.

Circumstances implicating Milk:—Of 422 houses canvassed in one locality, 196 supplied either wholly (160) or in part (36) by the incriminated milk. Of these 196 houses 115 invaded by diphtheria in a period of 8 days; and only 5 of the remaining 226 houses so invaded.

Facts showing Special Incidence of Disease:—One patient had the milk only at a friend's house in tea. The family took other milk at home, and all the rest of the household escaped.

Reference:—BRITISH MEDICAL JOURNAL, vol. ii, 1886, p. 397.

7.—YORK TOWN AND CAMBERLEY, SURREY.

Date of Outbreak: October, 1886. *Reporter:* W. H. Power, F.R.S., L.G.B. *Total Number of Cases:* 140. *Deaths:* 16. *Number of Cases amongst Drinkers of Suspected Milk:* 124. *Percentage to Total Cases:* 89. *Number of Families supplied by Milkman:* 94. *Number of such Families invaded:* 48. *Percentage:* 51.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived:—Well in use at farm found in two of three analyses made to be dangerously polluted, the impurities being deemed of vegetable origin, no evidence of sewage pollution being forthcoming. Well water always used for dairying purposes in a boiled state.

Exciting Cause of Outbreak:—Not definitely made out. Some people blamed contamination of milk by human agency; this not probable. Others deemed the use of polluted water as the cause; this not borne out by the facts. Most likely cause, the use of the milk of two cows after calving, their milk being brought into the business at a time parallel with the epidemic outburst of diphtheria.

Circumstances implicating Milk:—Of the 57 houses invaded, 48 (84 per cent.) took the implicated milk, and all were invaded in the ten days October 8th to 17th. Of 140 individuals attacked, 124 (88.5 per cent.) were consumers of the milk, and 16 of these (93.5 per cent.) were attacked in the same ten days.

Facts showing Special Incidence of Disease:—Amount of milk consumed seen to determine also amount of disease; thus, of better class families taking the milk, 84, and of poorer class, only 22 per cent. invaded. Of children under 15 years in the one and the other class, 54 and 6 per cent. respectively attacked. One case in a lady followed upon the consumption of some of the particular milk at a friend's house one day, the hostess also falling ill.

Reference:—Report to Local Government Board.

8.—EALING.

Date of Outbreak: January, 1887. *Reporter:* W. H. Power, F.R.S., L.G.B. *Total Number of Cases:* 30. *Number of Cases amongst Drinkers of Suspected Milk:* 26. *Percentage to Total Cases:* 86. *Number of Families supplied by Milkman:* 50. *Number of such Families invaded:* 14. *Percentage:* 28.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived:—No sanitary deficiency at either dairy or its associated farm premises.

Exciting Cause of Outbreak:—Not ascertained, owing to the withholding of much information of a valuable character by medical practitioners and residents. Milk vendor himself "afforded every assistance in his power to the inquiry."

Circumstances implicating Milk:—The data as to the total number of cases, the number of cases amongst drinkers of suspected milk, and percentage are based only on a special effort made in a particular section of the district to determine, if possible, the relations of the outbreak to the implicated milk. As a result, it was found that in January, of 126 households furnishing information, 50 took the milk and 28 per cent. were invaded, against less than 3 per cent. of the remaining 76 households; and that of the 422 inmates taking the milk, 6 per cent. were attacked, being tenfold greater than among the 633 persons getting other milk. Of children, over 7 in each 100 consumers of the milk were attacked, and not one of those consuming other milk. From an estimate formed as accurately as was possible it was deemed that among the 3,000 persons taking the implicated milk attacks of diphtheria and sore throat were, in the epidemic period, 20 times more than on households getting milk from other dairies.

Reference:—Report to the Local Government Board.

9.—ENFIELD.

Date of Outbreak: November and December, 1887. *Reporter:* Dr. R. Bruce Low, L.G.B. *Total Number of Cases:* 51. *Deaths:* 12. *Number of Cases amongst Drinkers of Suspected Milk:* 42. *Percentage to Total Cases:* 82. *Number of Families supplied by Milkman:* 210. *Number of such Families invaded:* 21. *Percentage:* 10.

Sanitary Circumstances of Farm or Dairy from which Milk was derived, and Exciting Cause of Outbreak:—The conditions of actual milk distribution, and the distance of time between the events and their investigation "presented difficulties as to elucidation of facts "insurmountable." *Circumstances implicating Milk:*—These 12 cases were a recrudescence of a much larger epidemic prevalence in 1887 due to school influence and other factors. The recrudescence attacks were limited alike in locality

and social status of sufferers, the latter being of the better class altogether, quite unlike the earlier manifestations of diphtheria. All the cases at the end of November and in the first three weeks of December, and all the deaths in this period, occurred in persons consuming milk from one source. Of the houses using the milk, 10 per cent. were invaded; of houses not using the milk, less than 1 per cent. Of persons consuming the milk, over 3, and of those not consuming it less than 0.5 per cent. were attacked.

Reference.—Report to the Local Government Board.

10.—CROYDON.

Date of Outbreak: October, 1890. Reporter: Dr. Philpot, M.O.H. Total Number of Cases: 191. Deaths: 38. Number of Cases amongst Drinkers of Suspected Milk: 123. Percentage to Total Cases: 65. Number of Families supplied by Milkman: 124. Percentage of such Families Invaded: 40.

Exciting Cause of Outbreak.—Teat eruptions in cows, stated by Dr. Klein to be similar to those met with in diphtheria outbreaks traced to milk of diseased cows.

Circumstances implicating Milk.—Milk from one source supplied by one dairy, the customers of which suffered to the extent of 40 per cent. of households supplied. Same milk formed one-seventh of the supply of another dairy, the customers of which suffered in 10 per cent. of households taking it. The milk from these two sources caused diphtheria in 12 per cent. of the households consuming it, against less than one-fifth per cent. of household invasions where the milk from other 31 sources was used. Proportion as 60 to 1. Cases ceased to arise when the implicated milk was stopped.

Reference.—Daily Graphic, February 3rd, 1891; and report of medical officer of health.

11.—CO. WORCESTER.

Date of Outbreak: November, 1891. Reporter: Dr. Thursfield, M.O.H. Total Number of Cases: 6. Deaths: 1. Number of Cases amongst Drinkers of Suspected Milk: 6. Percentage to Total Cases: 100. Number of Families supplied by Milkman: 1. Number of such Families invaded: 1. Percentage: 100.

Exciting Cause of Outbreak.—Two of three cows, the milk of which was used by the keeper's family and the rest made into butter, affected with particular disease of teats, pustules bursting in the act of milking, the cows being in a febrile state.

Circumstances implicating Milk.—All the children of the household had suffered from diphtheria some years back. Five of them and the mother were affected. One death, of a child. Mother and son who milked the cows, first attacked. No diphtheria elsewhere in locality.

Reference.—Public Health, 1891-92, p. 130.

12.—SURBITON.

Date of Outbreak: December, 1891. Reporter: Dr. Coleman, M.O.H. Total Number of Cases: 27. Deaths: 3. Number of Cases amongst Drinkers of Suspected Milk: 27. Percentage to Total Cases: 100.

Exciting Cause of Outbreak.—Inmates of country farm ill of diphtheria. Circumstances implicating Milk.—All cases were of persons taking the milk from the invaded farm. The cases stopped a week after the source of supply was changed.

Reference.—Public Health, 1891-92, p. 158.

13.—GLASGOW.

Date of Outbreak: August, 1892. Reporter: Dr. Russell, M.O.H. Total Number of Cases: 224.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived.—Business at both dairy and farm conducted with scrupulous attention to cleanliness. No insanitary conditions present.

Exciting Cause of Outbreak.—Nearly all of a herd of 53 cows suffered from teat eruptions, small in beginning, but leading to ulceration. Ulcers yielding faintly-coloured fluid; three or four on one teat; sometimes all teats affected. "Hendon" streptococcus isolated from lymph, as proved by growth and inoculation into mice. Two varieties of eruption in question shown by experiments on calves with scabs from ulcers, one being true vaccinia, the other a non-vesicular eruption of a specific character like that of "Camberwell" outbreak. No suggestion of desquamation or evidence of constitutional disturbance in cattle, as observed in Hendon and Camberwell cases. Farmer and three other milkers had eruptive sores on hands, one being compelled to stop work.

Circumstances implicating Milk.—Between August 6th and 8th, from 60 to 70 cases notified. Milk supply stopped on 8th; cases ceased on 12th. On latter date all cattle seemingly recovered separated from rest, and milk sold unmixed from 2nd till 30th, when supply again stopped. Cases cropped up on 25th and occurred daily till September 8th, all among consumers of this milk.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1892, pp. 432, 666; vol. i, 1893, p. 35.

14.—LIMEKILNS (VILLAGE IN FIFESHIRE).

Date of Outbreak: August to December, 1892. Reporter: Dr. Nasmyth, M.O.H. Total Number of Cases: 28. Deaths: 4. Number of Cases amongst Drinkers of Suspected Milk: 16. Percentage to Total Cases: 57. Number of Families invaded: 14.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Farm large, well conducted.

Exciting Cause of Outbreak.—Occurrence of case of diphtheria in farmhouse. Patient found walking about the dairy premises day after notification. No attempt at isolation, but boy going into byres and all about the place. Direct communication between those attending boy and those managing the dairy.

Circumstances implicating Milk.—Occurrence of epidemic amongst a large proportion of the families using the milk from this particular dairy at commencement of epidemic.

Reference.—Annual Report for 1892.

15.—FINCHLEY.

Date of Outbreak: November, 1894. Reporter: Dr. Kenwood, M.O.H.

Exciting Cause of Outbreak.—Three cows supplying the milk had diseased teats, and one had a chronic abscess of her udder.

Circumstances implicating Milk.—From November 8th to 18th there were 94 per cent. of the houses supplied by the dairy invaded by the throat malady. The disease attacked all classes, and especially adults over 20 years of age. Twenty-four hours after issue of a notice to boil all milk, the epidemic ceased as suddenly as it started.

Facts showing Special Incidence of Disease.—Better class houses, and generally those using most milk, suffered in greatest degree. After cessation of the throat epidemic, true diphtheria, but of a mild type, grew up in the district, 25 of the first 38 cases being in persons who had just before suffered from the throat malady. Only one diphtheria death resulted in whole quarter.

Reference.—BRITISH MEDICAL JOURNAL, 1895, vol. i, pp. 1167-68.

II.—SCARLATINA.

1.—WOLVERHAMPTON.

Date of Outbreak: April, 1881. Reporter: Dr. Love, M.O.H.

Exciting Cause of Outbreak.—Milk seller engaged in distributing milk during the illness of her children whom she nursed through an attack of scarlatina.

Circumstances implicating Milk.—Cases occurred outside the milk seller's house easily traceable to the milk which she supplied. She was ordered to cease delivering milk, a penalty being imposed for disobedience to order issued.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1881, p. 819.

2.—GREENOCK.

Date of Outbreak: October, 1881. Total Number of Cases: 100.

Exciting Cause of Outbreak.—Cases of scarlatina recently in farmer's family.

Circumstances implicating Milk.—Nearly all the families attacked had milk from a particular farmer. Disease at first largely confined to working classes, but attacked better class later.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1881, p. 717.

3.—NORTH LONDON.

Date of Outbreak: January, 1882. Reporter: W. H. Power, F.R.S., J.G.B. Total Number of Cases: "Extensive outbreak." Type: "Mild." Number of Cases amongst Drinkers of Suspected Milk: Almost wholly. Percentage to Total Cases: Practically 100.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived.—Satisfactory.

Exciting Cause of Outbreak.—Some condition of one cow recently calved may be looked upon as the exciting cause of infective quality of the milk. She had lost portions of her coat, and her buttocks and posterior udder, when seen by Mr. Power in February, were fouled and stained by excremental matter, and perhaps by vaginal discharge as well.

Circumstances implicating Milk.—The implicated milk distributed to several sanitary areas in London, and the preponderance of attacks in consumers of the milk very marked in all of them. In period January 14th to 30th well nigh all the cases of scarlatina and throat illness in 1st. Giles were in drinkers of the milk; drinkers of milk from other sources almost entirely escaped. Of 39 concurrent cases in Camberwell, 82 per cent. drank the same milk. Certain families supplied with the milk en route from one of the London termini to the retailer's premises also contracted scarlatina at the same time.

Facts showing Special Incidence of Disease.—Of 6 families belonging to railway servants purchasing some two to three imperial gallons daily of the milk on its reaching Charing Cross Station, 13 members fell ill of scarlatina during the same epidemic period.

Reference.—Report to the Local Government Board.

4.—GREENOCK.

Date of Outbreak: January and February, 1882. Reporter: Dr. Wallace, M.O.H. Total Number of Cases: 20. Number of Cases amongst Drinkers of Suspected Milk: All. Percentage to Total Cases: 100. Number of Families taking the Milk invaded: 11.

Exciting Cause of Outbreak.—Scarlatina in dairyman's family; 4 cases, initial case dating from January 19th.

Circumstances implicating Milk.—Up to February 1st 20 cases were notified in 11 families using milk from the dairy in question. No cases reported after the milk supply was stopped.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1882, p. 437.

5.—SUNDERLAND.

Date of Outbreak: July, 1882. Reporter: Dr. Harris, M.O.H. Deaths: 4.

Exciting Cause of Outbreak.—Existence of scarlatina in a dairy.

Circumstances implicating Milk.—Four deaths in the neighbourhood found to have occurred among consumers of milk from the infected dairy. Number of non-fatal attacks not known. Illness at dairy not reported, and only accidentally discovered.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1882, p. 100.

6.—GREENOCK.

Date of Outbreak: October and November, 1882. *Reporter:* Dr. Wallace, M.O.H. *Total Number of Cases:* 47. *Number of Cases amongst Drinkers of Suspected Milk:* 12. *Percentage to Total Cases:* 26.

Exciting Cause of Outbreak.—Unrecognised cases of scarlatina in the person of a milk dealer and of his child. Cases not medically attended.

Circumstances implicating Milk.—Occurrence of cases of scarlatina among consumers of the particular milk service led to discovery of disease in milk dealer's house. Dr. Wallace regards 8 out of 26 cases in October as "clearly connected with this contaminated milk," and 4 out of 21 cases in November as "unquestionably" due to the same cause.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1882, p. 1325.

7.—HULL.

Date of Outbreak: 1882. *Reporter:* J. Mason, M.O.H.

Exciting Cause of Outbreak.—Case of scarlatina in a child at a milk shop three weeks before the local sanitary authority had knowledge of its existence. No precautions had been taken to safeguard the milk from infection.

Circumstances implicating Milk.—Milk supply stopped when disease at dairy heard of, but Mr. Masou later discovered scarlatina at five centres in the town, each having its origin in the infected dairy.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1883, p. 334.

8.—WOLBOROUGH.

Date of Outbreak: April, 1883. *Reporter:* Medical Officer of Health. *Number of Families invaded:* 9.

Exciting Cause of Outbreak.—Good reason existed for believing that unreported cases of scarlatina existed recently in a dairyman's family, the milk being taken as usual into the infected house prior to distribution to customers.

Circumstances implicating Milk.—Of 16 families invaded by the disease, 9 had their milk from the infected house.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1883, p. 780.

9.—DUNDEE.

Date of Outbreak: October, 1883. *Total Number of Cases:* 17. *Deaths:* 4. *Number of Cases amongst Drinkers of Suspected Milk:* 17. *Percentage to Total Cases:* 100. *Number of Families taking the Milk invaded:* 12.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Part of dwelling house used as a dairy, the means of ventilation, cleansing, drainage, and water supply not being such as to ensure protection of milk against contamination.

Exciting Cause of Outbreak.—Milk stored in kitchen where a boy was lying ill of scarlatina, and milk business carried on by dairyman's wife and servant after recent contact with the patient.

Circumstances implicating Milk.—All the cases notified occurred within four days in consumers of the infected milk, the per-case mortality being 24 per cent.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1883, p. 839.

10.—NORTH LONDON AND HENDON.

Date of Outbreak: November and December, 1885. *Reporter:* Mr. W. H. Power, F.R.S., L.G.B. *Percentage to Total Cases of Attacks in Persons drinking the Suspected Milk:* "A strikingly large proportion."

Sanitary Circumstances of Farm or Dairy from which the Milk was derived.—"Sanitarily perfect."

Exciting Cause of Outbreak.—A condition of certain milch cows, which had for its outward manifestations an eruption of teats and udders, and which was communicable from cow to cow. Subcultures of the ulcerous discharge of the affected animals as well as the original discharged matter itself, produced in calves into which the material was inoculated a disease having unmistakable affinities under some conditions with the disease in the milch cows, and under other conditions with scarlatina in the human subject.

Circumstances implicating Milk.—The disease appeared simultaneously in all but one of the five localities to which the implicated milk was distributed after absence of scarlatina for some time previously. The escape of the one locality seen later to have deep significance, since the special condition of certain milch cows was found to govern the specific nature of the milk distributed, and these cows, on being added to the general from the "quarantine" sheds, did not enter that one of the three sheds from which milk was sent to the exempted area. Only during the period of inquiry when cow movements led to communication of the cow malady to this third shed—just prior to stoppage of the milk service—did the area in question begin to contribute cases of scarlatina among consumers of the milk. In 2 sanitary districts intermission of scarlatina cases among drinkers of the milk was noticed during a well-defined period of ten days during which freedom from the cow disease of the animals in the shed furnishing milk to those two districts was ascertained by close inquiry. The cow first to suffer was a newly-imported animal brought into the general service of the farm a week prior to commencement of the outbreak. Other 3 cows—1 introduced the same day and the remaining 2 some fortnight later—were found to be suffering in like manner; and all at dates and in sheds coinciding with observed prevalence of scarlatina in localities served by milk from them and other milch cows afterwards affected.

Facts showing Special Incidence of Disease.—When the sale of the milk was prohibited in London some of it got clandestinely distributed among poor people at Hendon; and among the few thus served half-a-dozen families were invaded by scarlatina at a time when the disease had ceased to exert its influence in the London districts.

Reference.—Report to the Local Government Board.

11.—WIMBLEDON AND MERTON.

Date of Outbreak: December, 1886, and January, 1887. *Reporter:* Mr. W. H. Power, F.R.S., L.G.B. *Total Number of Cases:* 545. *Number of Cases amongst Drinkers of Suspected Milk:* 403. *Percentage to Total Cases:* 90.5. *Number of Families supplied by Milkman:* 274. *Number of such Families invaded:* 172. *Percentage:* 63.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Satisfactory.

Exciting Cause of Outbreak.—Not definitely ascertained. But of the cows seen, "some few appeared to be recovering from affection of the skin and udder, very similar to the malady reported on by Dr. Klein as having occurred among certain cows at Hendon" (see No. 10).

Circumstances implicating Milk.—No fewer than 431 attacks occurred in a single week, at the end of December. The sale of the milk was prohibited on December 31st. The malady ceased to operate some 16 days later. In this epidemic week consumers of the implicated milk suffered 700 times as much as consumers of milk from other sources, and throughout the entire period in the proportion of 100 to 1. Where the milk was distributed generally and abundantly, the disease appeared in corresponding intensity, following particular roads or streets and passing others, according as the milk did or did not go there.

Facts showing Special Incidence of Disease.—Disease fell especially on well-to-do people, and was seen to attack most largely those who consumed most milk, and the rateable value of houses and quantity of milk used being important factors in determining the amount of disease to be expected.

Reference.—Report to the Local Government Board.

12.—STAPLETON.

Date of Outbreak: April, 1887. *Reporter:* Dr. W. Brown, M.O.H. *Total Number of Cases:* 11. *Deaths:* 4. *Number of Cases amongst Drinkers of Suspected Milk:* 11. *Percentage to Total Cases:* 100. *Number of Families Supplied by Milkman:* Some 50 or 60. *Number of such Families Invaded:* 6. *Percentage:* 10.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Cows drank the contents of a large stagnat pool, which received the drainage from several cottages, from neighbouring fields, and from heaps of horse and cow manure near at hand.

Exciting Cause of Outbreak.—Pool from which the cows drank, and in the contents of which some of the dairying vessels were washed, polluted by sewage.

Circumstances implicating Milk.—All the cases were in drinkers of the one milk supply, and all the households save one got the milk through a local retailer, the remaining household getting it direct from the farm.

Reference.—Monthly Report of M.O.H.

13.—? NORFOLK.

Date of Outbreak: December, 1887. *Reporter:* Dr. H. Mallins. *Total Number of Cases:* 5. *Number of Cases amongst Drinkers of Suspected Milk:* 5. *Percentage to Total Cases:* 100.

Exciting Cause of Outbreak.—Rash on teats of cow, and milk, when allowed to stand, of distinctly greyish colour. Cow also had a "humour" all over its body, the rash having the appearance of small red pimples. Later on cow desquamated freely.

Circumstances implicating Milk.—The 5 cases were all of children in 1 family. All had first an affection of the mouth, and later they manifested a vesicular eruption.

Reference.—Lancet, 1888, vol. i, p. 119.

14.—JESMOND-ON-TYNE.

Date of Outbreak: January and February, 1888. *Reporter:* Dr. H. Armstrong, M.O.H. *Total Number of Cases:* 19. *Number of Cases amongst Drinkers of Suspected Milk:* 17. *Percentage to Total Cases:* 89.

Exciting Cause of Outbreak.—Illness, suggestive of scarlatina, in the families of two milkmen supplying the implicated milk, upwards of three months prior to outbreak.

Circumstances implicating Milk.—All the cases arose in eleven days, and of the 19 cases in 16 households, 17 were of persons having only the milk supply in common.

Reference.—Public Health, 1888-89, p. 24.

15.—POLLOKSHIELDS NEAR GLASGOW.

Date of Outbreak: June, 1888. *Reporter:* Dr. Carmichael. *Total Number of Cases:* 70. *Deaths:* "Several." *Number of Cases amongst Drinkers of Suspected Milk:* 70. *Percentage to Total Cases:* 100.

Exciting Cause of Outbreak.—Cases of scarlet fever in the persons of the servant and children of the farm supplying the milk.

Circumstances implicating Milk.—All the persons affected partook of the implicated milk.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1888, p. 32.

16.—NEWCASTLE-ON-TYNE.

Date of Outbreak: July, 1888. *Reporter:* Dr. H. Armstrong, M.O.H. *Total Number of Cases:* 74. *Number of Cases amongst Drinkers of Suspected Milk:* 61. *Percentage to Total Cases:* 82.

Exciting Cause of Outbreak.—Three children in family of one man attending cows ill of scarlatina-like disease.

Circumstances implicating Milk.—All the 61 cases occurred in the space of 13 days, the outbreak being localised, after absence of the disease from the city, and only 13 additional cases occurring in the rest of the town.

Reference.—Public Health, 1888-89, p. 156.

17.—GLASGOW.

Date of Outbreak: October, 1888. *Reporter:* Dr. Russell, M.O.H. *Total Number of Cases:* 56. *Number of Cases amongst Drinkers of Suspected Milk:* 43. *Percentage to Total Cases:* 77. *Number of Families supplied by Milkman:* 363. *Number of such Families invaded:* 29. *Percentage:* 8.

Exciting Cause of Outbreak.—Members of families of two dairymen ill from ill-defined throat affections following on scarlet fever in other members at one of the shops. Family relations of two businesses interlaced.

Circumstances implicating Milk.—Of 56 cases which occurred within a period of 5 weeks, 40 cropped up in 4 days. Outbreak limited to well-to-do part of city, among persons consuming large quantities of milk, and limited in its epidemic outburst to consumers of the implicated milk.

Facts showing Special Incidence of Disease.—Amount of milk related to quantity of and severity of disease.

Reference.—*Lancet*, 1888, vol. ii, p. 1079.

18.—UPTON AND MACCLESFIELD.

Date of Outbreak: February, 1889. *Reporter:* Dr. Parsons, L.G.B. *Total Number of Cases:* 129. *Number of Cases amongst Drinkers of Suspected Milk:* 123. *Percentage to Total Cases:* 93. *Number of Families supplied by Milkman:* 100. *Number of such Families Invaded:* 58. *Percentage:* 58.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Well 7 yards from privy and pigstyes, and its contained water found on analysis to be polluted by sewage.

Exciting Cause of Outbreak.—Milk cans rinsed out with cold water from this well, but this not deemed the means by which the milk got contaminated. Most likely cause, the use of the milk of a cow recently calved. Later on this cow was found to have developed vesicular sores on her teats, and her milk was then rejected. She had lost flesh.

Circumstances implicating Milk.—The outburst was sudden after long absence of scarlatina, much throat illness being prevalent in this outburst, and 2 cases of undoubted diphtheria. All but 6 cases in Upton (2 of scarlatina in school children, 1 of sore throat, and 3 of "mumps") occurred among consumers of the milk. Of households using the milk in that village 77 per cent. invaded, and 37 per cent. of members attacked, as compared with 17 and 5 respectively outside the milk run.

Facts showing Special Incidence of Disease.—In whole outburst there was a difference as between 45 and 89 per cent. of households attacked according as $\frac{1}{2}$ pint or a whole pint and upwards was taken daily, and a difference as between 12 and 50 per cent. of members of these households attacked.

Reference.—Report to Local Government Board.

19.—BRISTOL.

Date of Outbreak: December, 1890, to February, 1891. *Reporter:* Dr. D. S. Davies, M.O.H. *Total Number of Cases:* 284. *Deaths:* 15.

Exciting Cause of Outbreak.—Not ascertained.

Circumstances implicating Milk.—Epidemic sudden, and cessation well marked. Well-to-do families largely attacked. Of the 205 households invaded, 74, or 34 per cent., were supplied by milk from one farm. In the districts most heavily attacked 1 in each 40 of the total houses was invaded, against 1 in each 7 taking the implicated milk.

Reference.—*Public Health*, 1891-92, p. 363.

20.—SUTTON COLDFIELD.

Date of Outbreak: February-April, 1891. *Reporter:* Dr. Bostock Hill, M.O.H. *Total Number of Cases:* 40. *Deaths:* 5. *Cases amongst Drinkers of Suspected Milk:* Almost without exception.

Exciting Cause of Outbreak.—One cow recently calved, much emaciated, with some indication of recent ulceration on teats. Later she had extensive patches of desquamation, an ulcer on one teat, and an eruption on the udder. Appearances those of Hendon outbreak of 1885. A second cow presenting slight indications of same condition.

Circumstances implicating Milk.—All the 17 houses first invaded took the implicated milk. Outbreak of two "explosions," coinciding in time with ulceration and eruptive conditions of the newly-calved cow. Cases almost without exception in consumers of the milk from the farm where the cow in question was furnishing milk. Only 1 or 2 sporadic cases of scarlet fever occurred after the sale of the milk had been stopped.

Facts showing Special Incidence of Disease.—Only 8 cases in children under 5 years of age, whilst 6 were in persons aged over 20 years.

Reference.—*BRITISH MEDICAL JOURNAL*, vol. ii, 1891, p. 136.

21.—BUSH HILL PARK, ENFIELD.

Date of Outbreak: November, 1891. *Reporter:* Dr. Copeman, L.G.B. *Total Number of Cases:* 33. *Number of Cases amongst Drinkers of Suspected Milk:* 33. *Percentage to Total Cases:* 100. *Number of Families supplied by Milkman:* Information withheld. *Number of such Families Invaded:* 23. *Percentage:* Information withheld.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—No fault could be found with local dairy premises, nor with the distant farm supplying the milk.

Exciting Cause of Outbreak.—Not definitely ascertained, but some of the cows had abraded teats: some had boils on their udder; one cow had a vesicular scab, but Dr. Klein failed to discover any streptococcus corresponding with that in the case of the Hendon cow malady.

Circumstances implicating Milk.—The outbreak was limited to the eight days, November 17th to 24th, and occurred in two sanitary districts, every one of the cases being among customers of the one dairyman, 23 households being invaded, and 33 members attacked. The disease was more largely incident on better class houses taking most milk. Confirmatory evidence implicating milk came from the Essex village where the dairy farm was situate, the only two houses invaded coincidentally being two to which the milk in question was delivered—except that one other girl fell ill who had had opportunities of helping herself to the milk.

Facts showing Special Incidence of Disease.—In dairyman's own family, the infant fed on "nursery" milk from his own cow escaped; his little daughter drinking the Essex milk, sickened with scarlatina.

Reference.—Report to the Local Government Board.

22.—CHARLTON.

Date of Outbreak: March-April, 1892. *Reporter:* Dr. Hamer, L.C.C. *Total Number of Cases:* 57+?. *Number of Cases amongst Drinkers of Suspected Milk:* 56+?.

Exciting Cause of Outbreak.—Illness of one cow, milk ropy, severe cold, udder and teats presented scabs and excoriations.

Circumstances implicating Milk.—Percentages of cases of scarlatina, arising in seven separate (and some of them widely separated) localities, taking milk from the service during the epidemic periods, varied from 10 to 91. Epidemic began within a day or two of commencement of cow's illness, in six different localities; fresh cases ceased to occur, except in two localities to which alone the cow's milk was distributed, in the second week of her illness; cases entirely ceased after the cow was totally excluded from the business.

Reference.—*Public Health*, 1891-92, p. 366.

23.—ASTON MANOR AND HANDSWORTH.

Date of Outbreak: April to July, 1892. *Reporter:* H. May, M.O.H. *Total Number of Cases:* 266. *Deaths:* 7. *Number of Cases amongst Drinkers of Suspected Milk:* 167. *Percentage to Total Cases:* 51.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Well water in a polluted state.

Exciting Cause of Outbreak.—Not traced. [The cows at the two implicated farms were examined after some time had elapsed since the exceptional prevalence of scarlatina had attracted attention and were at that period found, in the opinion of the veterinary inspector, to be "sound and in perfect health."]

Circumstances implicating Milk.—Greatly increased prevalence of scarlatina in both districts from April to July. In Handsworth, in the 14 weeks ended July 6th, the percentage of persons attacked who drank the suspected milk was no less than 60. In Aston Manor, from May 2nd to June 20th the percentage was as high as 62, as many as 21 cases occurring in one "round." After these dates the disease suddenly ceased. The majority of the families attacked had their milk from 2 connected dairy farms by way of numerous milk sellers and milk shops. [The disease did not spread through the schools; rarely more than 1 case in a house; an unusual number of persons over school age attacked; and 4 or 5 milk sellers' families invaded.]

Reference.—Annual report of Medical Officer of Health for 1892.

24.—GLASGOW.

Date of Outbreak: August, 1892. *Reporters:* Drs. Russell and Chalmers. *Total Number of Cases:* 236. *Deaths:* 11. *Number of Cases amongst Drinkers of Suspected Milk:* 236. *Percentage to Total Cases:* 100. *Number of Families supplied by Milkman:* 359+?. *Number of such Families Invaded:* 152.

Sanitary Circumstances of Farm or Dairy from which the Milk was Derived.—All that could be desired.

Exciting Cause of Outbreak.—Ulcerative eruption on the udders and teats of the cattle—vesicular, quasi-pustular in form, crusted with blackened centre. Such are some of the terms applied to the affection, which was communicable by some means from cow to cow and from shed to shed. Sores also formed on the hands of some of the milkers. Condition of teats only discovered on cows becoming restive under action of being milked. Dr. Klein found the disease in these milk cows to be allied in some points to that in the Hendon and Camberwell milkborne epidemics.

Circumstances implicating Milk.—Disease incidence confined to the milk service of one dairy getting milk from two farms. Milk from the implicated farm mostly used on first morning round, 57 families and 91 individuals being attacked out of 193 families supplied on this round. The mixed milk always used on second round, and 59 individuals in 37 (out of 166) families attacked thereon. The counter trade mostly with the implicated milk, 86 persons in 58 families being attacked. Some of the unsuspected milk was transferred each day to another dairy during part of the epidemic period. No cases of scarlet fever occurred in the customers of the dairy so served. The suspected milk was stopped on August 7th. No cases traceable directly to the agency of the milk occurred later than August 20th.

Facts showing Special Incidence of Disease.—In one street 21 families (more than half those supplied with the milk) yielded 29 cases; some streets taking the milk suffered no attacks. The active principle of contagion thus apparently not uniformly distributed.

Reference.—Special Report of Medical Officer of Health.

25.—LANGHAM, ESSEX.

Date of Outbreak: October, 1892. *Reporter:* J. Cook, M.D., M.O.H. *Total Number of Cases:* 5. *Number of Cases amongst Drinkers of Suspected Milk:* All. *Percentage to Total Cases:* 100. *Number of Families supplied by Milkman:* 2. *Number of such Families invaded:* 2. *Percentage:* 100.

Exciting Cause of Outbreak.—Suspicious udder eruptions on 2 cows at farm.

Circumstances implicating Milk.—Milk used only at farm and a other dwelling. Both invaded, 4 cases occurring in 1 day.

Facts showing Special Incidence of Disease.—A visitor at one of the dwellings stayed one night, partook of the milk, and afterwards developed scarlatina.

Reference.—Report of Medical Officer of Health.

26.—LEYTON.

Date of Outbreak: 1892. *Reporter:* M.O.H. *Total Number of Cases:* 51. *Exciting Cause of Outbreak.*—Farmer and several members of family at a farm supplying milk suffering from scarlet fever.

Circumstances implicating Milk.—One dealer had 39 cases amongst his customers. Milk derived from farm in question.

Reference.—*BRITISH MEDICAL JOURNAL*, vol. ii, 1892, p. 704.

27.—HASTINGS.

Date of Outbreak: November, 1893. *Reporter:* Dr. Scarlyn Wilson, M.O.H. *Total Number of Cases:* 40. *Deaths:* 1. *Number of Cases amongst Drinkers of Suspected Milk:* 30. *Percentage of Total Cases:* 75. *Number of Families supplied by Milkman:* 64. *Number of such Families invaded:* 20. *Percentage:* 31.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Cowsheeds badly drained and ill-paved and deficient in ventilation.

Exciting Cause of Outbreak.—Cows in a febrile condition, due doubtless to insanitary character of their housing accommodation. A sample of mixed milk of the several cows showed bacteria (character not determined) on analysis.

Circumstances implicating Milk.—Scarlatina, which had hitherto chiefly affected the poorer quarters, suddenly blazed out in better class houses exclusively, and three-quarters of the homes invaded dealt with one dairyman.

Facts showing Special Incidence of Disease.—Many of the patients were large milk consumers. In one school of 20 boys, the only 2 attacked were the only partakers of the milk separately each morning. In another instance, the only patient in an invaded household alone drank the milk unboiled. In yet another case, the patient, a large milk drinker, had been isolated for influenza for 12 days, and caught the disease in this interval of time.

Reference.—Annual Report for 1893.

28.—GLASGOW.

Date of Outbreak: December, 1893. *Reporter:* Dr. Chalmers, Assistant M.O.H. *Total Number of Cases:* 30. *Number of Cases amongst Drinkers of Suspected Milk:* 28. *Percentage to Total Cases:* 93. *Number of Families supplied by Milkman:* 80. *Number of such Families invaded:* 11. *Percentage:* 13.7.

Exciting Cause of Outbreak.—Illness of a scarlatinal character among the servants at the two dairy farms supplying the invaded houses with the implicated milk.

Circumstances implicating Milk.—Illness of customers from the one farm almost wholly confined to those taking milk from the cart attended by the initially attacked farmhand. On December 21st the sale of the milk was stopped on the seizure and removal of one of the milkers. On the other farm, hands fell ill about the middle of the month, there being intimate relations between the two farms.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1894, p. 426.

29.—RICHMOND, SURREY.

Date of Outbreak: February, 1894. *Reporter:* Dr. Rowland, M.O.H. *Total Number of Cases:* 55. *Number of Cases amongst Drinkers of Suspected Milk:* 52. *Percentage to Total Cases:* 95. *Number of Families supplied by Milkman:* 416. *Number of such Families invaded:* 26. *Percentage:* 6.

Exciting Cause of Outbreak.—Prevalence of scarlet fever in the vicinity of the farms supplying milk to the dairy.

Circumstances implicating Milk.—The outbreak had a short course of 9 days, and suddenly terminated. All the cases, save 3, were in consumers of the implicated milk.

Reference.—Annual Report for 1894.

30.—BLACKHEATH.

Date of Outbreak: March, 1894. *Reporter:* Mr. Shirley Murphy. *Total Number of Cases:* 89. *Number of Cases amongst Drinkers of Suspected Milk:* 79. *Percentage to Total Cases:* 89.

Exciting Cause of Outbreak.—Cows newly calved on dairy premises; also cattle having udder affections. But no causal connection with the outbreak made out in the case of these milk cows.

Circumstances implicating Milk.—Cases increased very rapidly, all but 10 being in persons using milk from A., either directly or by way of the retailer B. Persons procuring milk from B., but derived elsewhere than at A.'s dairy, not attacked. Of the 79 attacks in consumers of the implicated milk 55 took milk from A. (he selling 27 gallons daily), and 24 from A. *vid B.* (who sold 17 gallons daily). Outbreak ceased after milk supply was stopped.

Facts showing Special Incidence of Disease.—No one using the "nursery" milk from certain cows was attacked.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1894, p. 324.

31.—WOLVERHAMPTON.

Date of Outbreak: August, 1894. *Reporter:* Dr. Malet, M.O.H. *Total Number of Cases:* 55. *Deaths:* 1. *Number of Cases amongst Drinkers of Suspected Milk:* 15. *Percentage to Total Cases:* 27. *Number of Families Supplied by Milkman:* 50. *Number of such Families Invaded:* 11. *Percentage:* 22.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Nothing wrong found in regard of sanitary conditions.

Exciting Cause of Outbreak.—Not definitely ascertained; but a child desquamating after scarlatina was going about freely in the cottage of the shepherd who regularly assisted the cowman in milking the cows.

Circumstances implicating Milk.—There was a very special incidence on customers of the particular milk service, all from the one farm, the whole of the milk produced there being taken by the dairyman. The incidence was limited to the period, August 13th to September 2nd.

Facts showing Special Incidence of Disease.—All the invaded households were those of well-to-do families.

Reference.—Report of Medical Officer of Health.

32.—SHIRLEY WARREN, SOUTHAMPTON.

Date of Outbreak: August and September, 1894. *Reporter:* Dr. Shirley, M.O.H. *Total Number of Cases:* 11. *Number of Cases amongst Drinkers of Suspected Milk:* 9. *Percentage to Total Cases:* 82. *Number of Families supplied by Milkman:* 18. *Number of such Families Invaded:* 4. *Percentage:* 22.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—No special room for lodging milk, which was placed in a vessel without a cover in a penthouse attached to the back of the house, to which, also, the adjoining house had access, both dwellings being under the same roof.

Exciting Cause of Outbreak.—A boy in the house next the dairy premises had unrecognised scarlatina, imported from outside while staying on a visit. He was discovered to be peeling on September 7th, and having access to the penthouse, probably infected the milk.

Facts showing Special Incidence of Disease.—All four houses supplied by the milk from this farm attacked, and adjoining houses, supplied by milk from other sources, escaped invasion by scarlatina.

Reference.—Report of medical officer of health, BRITISH MEDICAL JOURNAL, vol. ii, 1894, pp. 956, 1408.

III.—TYPHOID.

1.—LEICESTER INFIRMARY.

Date of Outbreak: April, 1882. *Reporter:* Dr. Buck, M.O.H. *Total Number of Cases:* 14. *Deaths:* 2. *Number of Cases amongst Drinkers of Suspected Milk:* All. *Percentage to Total Cases:* 100.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Well situate near the end of the house drain, and also near an overflowing and leaky cesspool, analysis showing the water to be polluted with sewage.

Exciting Cause of Outbreak.—The washing of the milk cans with the water of the polluted well.

Circumstances implicating Milk.—All the patients drank milk from the farm in its raw state. The farmer and the vendor of the milk were among the sufferers. The cases in the infirmary were all those of dressers, nurses, and servants.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1882, p. 549.

2.—GLASGOW.

Date of Outbreak: May and June, 1882. *Reporter:* Dr. Russell, M.O.H. *Total Number of Cases:* 59. *Deaths:* 6. *Number of Cases amongst Drinkers of Suspected Milk:* 50. *Percentage to Total Cases:* 85.

Circumstances implicating Milk.—All the deaths from enteric fever in the western district, and 85 per cent. of the cases were in consumers of milk from one dairy; and house-to-house visitation in the seven contiguous streets where these infected persons resided failed to discover a single case of fever in consumers of milk from other sources.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1882, p. 61.

3.—CLAPHAM.

Date of Outbreak: June and July, 1882. *Reporter:* Dr. Parsons, L.G.B. *Total Number of Cases:* 22. *Deaths:* 3. *Number of Cases amongst Drinkers of suspected Milk:* 21. *Percentage to Total Cases:* 95. *Number of Families supplied by Milkman:* 118. *Number of such Families invaded:* 16. *Percentage:* 14.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived.—Two farms in question; at 1, well so situate as to be exposed to excremental pollution from a brook into which sewage of adjacent village flowed. Cattle drank of the brook in winter. Analysis showed well to be polluted. At the other farm, well underneath the dairy, its contents "in all probability largely polluted by sewage or surface drainage." At this farm two cases of "low fever" in October, 1881.

Exciting Cause of Outbreak.—The unquestionable pollution of well at first farm; existence at a recent date of 6 cases of typhoid fever in 3 houses in adjacent village draining to brook, and the evident possibility of contamination of well water by the percolation of the brook contents "indicate a channel by which infection may have gained access to the milk" by can rinsings and the like.

Circumstances implicating Milk.—All the cases, save 1, in houses served by the implicated milk. In almost all instances the patients were large milk drinkers, mostly children, but a few servants and young adults. All were in consumers of the "ordinary milk" as opposed to "nursery milk." In very many households which escaped invasion the amount of milk used was extremely small. Four invaded houses alone took $3\frac{1}{2}$ of the 32 gallons of ordinary milk daily distributed.

Facts showing Special Incidence of Disease.—In 1 household of 15 persons, the only one attacked was a drinker of the milk in its raw state.

Reference.—Report to the Local Government Board. BRITISH MEDICAL JOURNAL, vol. ii, 1882, pp. 142, 216, 816.

4.—SHELF.

Date of Outbreak: August and September, 1882. *Reporter:* Dr. Britton, M.D., M.O.H. *Total Number of Cases:* 11. *Death:* 1. *Number of Cases amongst Drinkers of Suspected Milk:* All. *Percentage to Total Number of Cases:* 100.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived.—In back kitchen, used as a dairy, a sink full of dirty water. In adjoining place an untrapped drain communicating with manure heap and pigstyes; the drain coming to within 2 feet of table on which bowls of milk were stored, and actually in place of storage of milk cans an open door dividing

the rooms. Offensive accumulation of sewage from overflowing cesspool in front of house. Waters found on analysis to be unsatisfactory alike from well in kitchen and in adjacent field.

Exciting Cause of Outbreak.—Relative of farmer visited house on July 11th, fell ill on 21st, and was confined to house 3 weeks without medical attendance. Dr. Britton regards the case as one of mild typhoid. Relative's wife came to nurse him on August 14th, fell ill herself on 21st, with vomiting and purging, and died on September 6th; death registered as from a poplexy.

Circumstances implicating Milk.—All the cases occurred on 5 days, between August 24th and September 3rd. House-to-house visitation failed to trace any cases in persons other than consumers of the particular milk.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1882, p. 749.

5.—GLASGOW.

Date of Outbreak: September, 1882. *Reporter:* Dr. Russell, M.O.H. *Sanitary Circumstances of Farm or Dairy from which Milk was Derived.*—Bad. *Exciting Cause of Outbreak.*—Recent illness of a febrile character in farm house.

Circumstances implicating Milk.—Two suburbs of Glasgow visited by enteric fever, the cause of which was traced to milk from the infected farm.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1882, p. 590.

6.—GRANGEMONT.

Date of Outbreak: October, 1882. *Number of Cases amongst Drinker of Suspected Milk:* All. *Percentage to Total Cases:* 100.

Exciting Cause of Outbreak.—Case of enteric fever in house from which milk was supplied.

Circumstances implicating Milk.—All the cases occurred in families deriving milk from the infected house.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1882, p. 911.

7.—GLASGOW.

Date of Outbreak: 1882. *Number of Cases amongst Drinkers of Suspected Milk:* All. *Percentage to Total Cases:* 100.

Circumstances implicating Milk.—Sharp outbreak among the working class portion of a western district of Glasgow, all being consumers of one milk supply. Inquiry failed to discover the point of infection, but not one case discovered in a person not using the particular milk service.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1882, p. 954.

8.—GATESHEAD.

Date of Outbreak: February, 1883. *Reporter:* Dr. C. Green, M.O.H. *Total Number of Cases:* 44. *Deaths:* 6. *Number of Cases amongst Drinkers of Suspected Milk:* 44. *Percentage to Total Cases:* 100. *Number of Families taking the Milk Invaded:* 20.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Dairy utensils kept in dirty scullery.

Exciting Cause of Outbreak.—Enteric fever cases among the children on the farm.

Circumstances implicating Milk.—All the cases in households taking the one milk supply.

Reference.—Lancet, vol. ii, 1883, p. 986.

9.—EXETER.

Date of Outbreak: April, 1883. *Reporter:* Dr. L. Woodman, M.O.H. *Total Number of Cases:* 20. *Deaths:* 3. *Number of Cases amongst Drinkers of Suspected Milk:* 20. *Percentage to Total Cases:* 100. *Number of Families taking the Milk Invaded:* 8.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Dairy was supplied with water from a well into which a large cesspool overflowed. This dairy was situated outside city boundary.

Circumstances implicating Milk.—The only typhoid in Exeter was in the houses of persons taking this milk. No case occurred after the well was closed by order of the St. Thomas's Sanitary Authority on examination of water.

Reference.—Reports to Sanitary Committee. BRITISH MEDICAL JOURNAL, vol. i, 1883, p. 375.

10.—ST. PANCRAS.

Date of Outbreak: July to September, 1883. *Reporter:* Mr. S. F. Murphy, M.O.H. *Total Number of Cases:* 431. *Deaths:* 20. *Number of Cases amongst Drinkers of Suspected Milk:* 350. *Percentage to Total Cases:* 81. *Number of Families taking the Milk Invaded:* 276.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Proximity at one farm of cesspool to well, the water of which was used for rinsing milk utensils.

Circumstances implicating Milk.—The large proportion of cases in persons who were customers of one local milk dealer led to detailed inquiry, which resulted almost invariably in finding that houses supplied by other milk dealers escaped the disease. House-to-house visitation in the locality mostly affected failed to discover a case outside the customers of the suspected milk. Suspicion was found to rest particularly on one of 3 farms supplying the local dairyman, namely, that at St. Albans, in which town 12 persons were attacked during the first nine months of 1883, all but 1 being consumers of the farm milk; this exception, strange to say, received the same milk while at Kentish Town, where he evidently contracted the disease.

Facts showing Special Incidence of Disease.—Numerous instances occurred in which persons drank the suspected milk under special circumstances, and developed typhoid fever as the result.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1883, pp. 505, 535, 588, 653, 747.

11.—DUNDEE.

Date of Outbreak: October, 1883. *Total Number of Cases:* 118. *Number of Cases amongst Drinkers of Suspected Milk:* 82. *Percentage to Total Cases:* 70.

Exciting Cause of Outbreak.—Several members of dairyman's family suffering during October from enteric fever. One boy early in the month found to be sleeping in a room at the dairyman's premises communicating with the milk shop, and certified to be ill of "neuralgia."

Circumstances implicating Milk.—The cases all occurred within a period of 3 weeks. Steps taken at the end of that time to stop the milk supply on account of certified enteric fever in the dairyman's family, this action being taken under a local Act.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1883, p. 839.

12.—ABERDEEN.

Date of Outbreak: December, 1883. *Reporter:* Dr. Simpson, M.O.H. *Total Number of Cases:* 25. *Number of Cases amongst Drinkers of Suspected Milk:* 25. *Percentage to Total Cases:* 100.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Extremely bad.

Exciting Cause of Outbreak.—Foul watercourse flowing down a ditch, used for dairying purposes. Watercourse polluted by excreta from typhoid case. Dairyman's daughter ill from bowel complaint.

Circumstances implicating Milk.—All the cases seem to have consumed the one milk supply. Of 52 persons residing in the 13 invaded houses, 25 were attacked.

Facts showing Special Incidence of Disease.—In some instances the fever attacked only the single member of a household using the milk.

Reference.—Lancet, 1884, vol. i, p. 487.

13.—MID-WARWICKSHIRE SANITARY DISTRICT.

Date of Outbreak: 1883. *Reporter:* G. Wilson, M.D., M.O.H. *Total Number of Cases:* 12. *Deaths:* 1. *Number of Cases amongst Drinkers of Suspected Milk:* All. *Percentage to Total Cases:* 100.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Well, the water of which received pollution from a contiguous and leaky cesspool.

Exciting Cause of Outbreak.—Dairyman contracted typhoid fever through use of well water and died, the illness not being reported. Son also suffering from the disease when house visited by Dr. Wilson. The well water, having become specifically contaminated, was used to wash the milk cans, if not also to dilute the milk.

Circumstances implicating Milk.—All the cases occurred in persons getting milk from the infected dairy. The outbreak at once ceased when the milk supply was stopped.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1883, p. 1136.

14.—BANNOCKBURN.

Date of Outbreak:—1883.

Exciting Cause of Outbreak.—Two cases of fever in the family of a dairyman.

Circumstances implicating Milk.—Most of the persons affected were consumers of milk from the infected dairy. Several cases were fatal.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1883, p. 375.

15.—ST. ALBANS.

Date of Outbreak: May and June, 1884. *Reporter:* Mr. S. F. Murphy, L.G.B. *Total Number of Cases:* 131. *Number of Cases amongst Drinkers of Suspected Milk:* 86. *Number of Families supplied by Milkman:* 396.

Number of such Families invaded: 86. *Percentage:* 21.7.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Well at farm 100 feet deep, containing some 12 feet of water. Cesspit of bricks set in cement 20 feet distant.

Exciting Cause of Outbreak.—One of the milch cows calved at the farm on April 20th. Milk cans rinsed with water from the well, into the sides of which well the roots of a tree, covering both well and cesspit, were found to have penetrated, thus favouring percolation of cesspit contents to well.

Circumstances implicating Milk.—The milk from this farm gave rise to a considerable outbreak of enteric fever in North London in 1883 (No. 10). In the present outbreak, the farmer and seven retailers distributed the milk locally, and 21.7 per cent. of the households were invaded in the epidemic period. In the city itself the percentage was 21.1, against 6.14 on houses taking other milk, the one being 150 greater than the other. Of households in a particular section of St. Pancras, London, obtaining their milk from the same farm, 15.0 per cent. invaded.

Facts showing Special Incidence of Disease.—One visitor to the farm who drank a glass of the milk was attacked.

Reference.—Report to Local Government Board.

16.—DERBY.

Date of Outbreak: September and November, 1884. *Reporter:* Dr. Iliffe, M.O.H. *Total Number of Cases:* 289. *Deaths:* 31. *Number of Cases amongst Drinkers of Suspected Milk:* 258. *Percentage to Total Cases:* 89.

Number of Families Supplied by Milkman: 188. *Number of such Families Invaded:* 122. *Percentage:* 65.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Pump well on brink of ditch, the latter receiving, just above this pump, the drainage of a pigsty, and higher still, opening out as a cesspool, and being fouled by the slop water and privy refuse of two cottages. Ditch is "an open sewer." Pump so constructed that all waste water, however fouled, runs back into the well.

Exciting Cause of Outbreak.—Initial fever case at the farm, and napkins of this first typhoid patient washed in the pump trough; mother-nurse of patient engaging in washing the milk cans and milking the cows.

Circumstances implicating Milk.—First 15 outside invaded houses all using the implicated milk; and all but one of the first 37 houses attacked doing

likewise. Of 289 cases, only 31 in persons not known definitely to have partaken of the milk; but of these 31 doubtless some did so partake at odd times, since people frequently, in running short of milk, became chance customers of handiest milkman on his round. Milkman specially in question had two sources of supply, one from farm named above; second from a farm to which no exception could be taken; 19 cases among consumers of milk from latter, the milks not being mixed. But same can measure at times used for both milks, and infection from one to the other hence doubtless brought about, the houses earliest served by the thus contaminated measure suffering the bulk of these cases, as well as some houses at times served with the pure milk in the practically empty cans of the other and contaminated milk.

Facts showing Special Incidence of Disease.—In addition to facts just related, one man taking a glass of the implicated milk to his dinner, but living outside the area of supply, was attacked, and several other patients had just removed from this special area when attacked, all being consumers of the milk.

Reference.—Special Report of Medical Officer of Health.

17.—ABERDEEN.

Date of Outbreak: December, 1884. *Reporter:* Dr. Simpson, M.O.H. *Total Number of Cases:* 65. *Deaths:* 7. *Number of Cases amongst Drinkers of Suspected Milk:* 43.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived and Exciting Cause of Outbreak.—The surroundings of some of the farms supplying the milk to the patients such as to be likely sources of contamination.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1885, p. 193.

18.—HELSARVEL SUBDIVISION, MUNICIPALITY OF LEICHHARDT, SYDNEY.

Date of Outbreak: February, 1886. *Reporter:* Dr. J. Ashburton Thompson. *Total Number of Cases:* 40. *Deaths:* 5. *Number of Cases amongst Drinkers of Suspected Milk:* 38. *Percentage to Total Cases:* 95. *Number of Families supplied by Milkman:* 123. *Number of such Families invaded:* 28. *Percentage:* 22.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Eleven cows were kept, never stalled. The establishment was a house and small yard on an ordinary house lot; the former stood on one bank of a natural surface channel which bisected the yard. In the alluvial bed of this channel a well was dug about 10 feet deep; this was the only source of water to the premises, which were unsewered and served by a pail closet, which, however, the tenants emptied for themselves, burying the contents in the yard within a few feet of the well. The channel drained a small area well defined by high ridges, on which were 286 inhabited houses. All these were unsewered; about two-thirds or more were connected with a public water supply; additionally on this area were two cemeteries which held 10,000 dead bodies between them. The area could drain by the channel alone, and the well was consequently kept full in dry weather by slopwaters mainly.

Exciting Cause of Outbreak.—Mixture of the milk with well water. Two cases of typhoid had occurred in a house which had a pail closet, of which the contents were buried in its yard by the tenants, and which was so placed that infectious excreta could have been washed into the channel near the well by a storm which occurred during a dry season at a date which corresponded with that of commencement of the epidemic—namely, about a fortnight earlier.

Circumstances implicating Milk.—The case-rate among customers was equal to 61 per 1,000. The whole district contained 10,550 persons, and the time was during the annual fever season, yet in all the houses not supplied from the suspected dairy all the medical men entering the district for professional purposes could point only to 4 in which cases of fever had occurred.

Facts showing Special Incidence of Disease.—Between ages 15 to 30 years; 9 females were attacked to 3 males.

Reference.—Votes and Proceedings, Legislative Assembly, New South Wales.

19.—LANCING COLLEGE.

Date of Outbreak: July, 1886. *Reporter:* Dr. Kelly, M.O.H. *Total Number of Cases:* 15. *Deaths:* 3. *Number of Cases amongst Drinkers of Suspected Milk:* 15. *Percentage to Total Cases:* 100.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Dry stined well at farm, a foot away from, and the water level lower than, a drain trap. Main sewer from Shoreham also near well, which latter bore evident traces of pollution by sewage.

Exciting Cause of Outbreak.—Typhoid fever prevalent in Shoreham, but specific pollution of well not proved.

Circumstances implicating Milk.—Beside 14 cases in boys at the College and 1 case in a visitor, there were 30 to 100 cases of typhoid fever in Shoreham traced to milk from the suspected farm. All the patients at the College and the visitor had partaken of cream from the dairy (with strawberries) on the cricket field. Cream was used from two sources, but nothing could be found amiss as regards the other source.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1886, p. 380; *Practitioner*, 1886, ii, p. 223.

20.—CARLISLE.

Date of Outbreak: October, 1886; June, 1887. *Reporter:* Dr. Brown, M.O.H. *Total Number of Cases:* 36. *Deaths:* 5 + 2. *Number of Cases amongst Drinkers of Suspected Milk:* 33 certainly. *Percentage to Total Cases:* 92.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Milk storeroom a small pantry between (and continuous with) a kitchen and yard. In yard were a slaughterhouse, cowsheds, an ashpit, privy, containing evacuations of enteric fever patients, and two open middens used for disposal of cow manure. Within 15 feet of privy was water stand tap.

Exciting Cause of Outbreak.—Not well defined; numerous causes may have been at work. Fever patients on farm nursed by cow milkers, who wore for both operations the same clothes; air of milk store commingled

with that of the room in which a fever patient lay; milch cows of dairy farm suffering for a series of years from a communicable febrile disorder; and the milk would be subject to the emanations from the specifically polluted privy and the cow manure middens, such manure being thought of as having infective quality, owing to the ill-health of the cattle.

Circumstances implicating Milk.—There were 5 cases of a febrile character, 2 certainly of enteric fever, and 3 deaths therefrom at the farm, from October to March, all in consumers of the milk. Of the remaining 31 cases occurring in different parts of the city, all save 3 certainly partook of the milk, and most probably those 3 also. No compulsory notification in force. Other 12 doubtful cases were all in consumers of the particular milk.

Facts showing Special Incidence of Disease.—The disease specially attacked females and young persons of both sexes, as is usual in milkborne outbreaks.

Reference.—*Practitioner*, 1888.

21.—BANDON, CO. CORR.

Date of Outbreak: July, 1887. *Reporter:* Dr. J. J. Welypy. *Total Number of Cases:* 17. *Deaths:* 2. *Percentage of Cases in Consumers of the Milk to Total Cases:* 88. *Number of Families Supplied by Milkman:* 30. *Number of such Families Invaded:* 11. *Percentage:* 37.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived.—Disgracefully bad.

Exciting Cause of Outbreak.—One of the dairy hands developed enteric fever. Cause of infection in her case not known. There were 17 cases, and the epidemic was clearly traced to 1 farm, on which fever had broken out. Milk was sent direct to the customers, and of the 17 patients, 15 got their supply from this dairy; the sixteenth was brother to a girl who milked the cows, and though he denied having taken the milk, there is strong suspicion that the infection was conveyed to him from the same house; the seventeenth case had no connection with it, and must have contracted the disease elsewhere. It is interesting to note that the means of dissemination were similar in two epidemics (see also No. 39), and the extent of the outbreaks varied directly according to the area over which the contaminated milk was supplied. In 1887 it was only distributed to houses in the town, and the country escaped from the fever, while in 1893 both town and country received the infected milk, and the fever was not limited to either.

Reference.—Report to Local Government Board, Ireland.

22.—SPILSBY R.S.D.

Date of Outbreak: September, 1888. *Reporter:* Dr. F. J. Walker, M.O.H. *Total Number of Cases:* 12. *Deaths:* 1. *Number of Cases amongst Drinkers of Suspected Milk:* 12. *Percentage to Total Cases:* 100. *Number of Families supplied by Milkman:* 20. *Number of such Families invaded:* 9. *Percentage:* 45.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Privy vault (cemented) only 5 yards from well. Dairy and premises kept very clean. Water supply from well about 20 feet deep. Water declared on analysis to be suspicious, and thereupon well closed.

Circumstances implicating Milk.—All the cases were in houses taking milk from the one source. No case among the customers of 9 other milk vendors. Milk the only community of condition of the invaded households. No further cases occurred after the well was closed.

Reference.—Annual Report for 1888.

23.—STIRLING.

Date of Outbreak: February to May, 1889. *Reporter:* Dr. McFadyen, M.O.H. *Total Number of Cases:* 40 or 50. *Deaths:* 4. *Number of Cases amongst Drinkers of Suspected Milk:* All. *Percentage to Total Cases:* 100.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived.—Water supply to "old" farmhouse extremely polluted, and foul alike to taste and smell. Well contains dye stuff, found also in adjacent highly contaminated stream. "New" farmhouse watercloset inside house, its soil pipe running down also inside the house, and defectively-jointed, passing close to the milk storehouse.

Exciting Cause of Outbreak.—Cases of typhoid at the old and new farmhouses, the dejections from the first case probably polluting the water-closet drain, and thus leading to contamination of the air of the store house, and in this way of all milk subsequently stored there.

Circumstances implicating Milk.—All the cases could be traced to the consumption of the implicated milk.

Facts showing Special Incidence of Disease.—In one instance the only person in a family of 7 attacked was the single consumer of the milk. In another household of 7 persons, 3 taking the milk alone attacked.

Reference.—BRITISH MEDICAL JOURNAL, vol. i, 1889, p. 1250.

24.—DUNDEE.

Date of Outbreak: February to May, 1889. *Reporter:* Dr. Anderson, M.O.H. *Total Number of Cases:* 45. *Number of Cases amongst Drinkers of Suspected Milk:* 23. *Percentage to Total Cases:* 51.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Drain from cowshed found to be defective and untrapped.

Exciting Cause of Outbreak.—Eruptive disease on the teats of a newly-calved cow.

Circumstances implicating Milk.—Of 21 cases up to April 15th, all but 6 occurred in consumers of the milk in different parts of the city. On this date the diseased cow was removed from the business, and the remaining 8 cases may be looked upon as due to infection prior to that date.

Reference.—BRITISH MEDICAL JOURNAL, vol. ii, 1889, p. 465.

25.—MUNICIPALITY OF RANDWICK, SYDNEY.

Date of Outbreak: February 1890. *Reporter:* Dr. J. Ashburton Thompson. *Total Number of Cases:* 133. *Deaths:* 9. *Number of Cases amongst Drinkers of Suspected Milk:* 122. *Percentage to Total Cases:* 84. *Number of Families supplied by Milkman:* 218. *Number of such Families invaded:* 67. *Percentage:* 31.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Public water paid for by meter; and a well, or rather tank, had been preserved in the yard, as was said "for washing carts, etc." The local authority under the Dairies Supervision Act had repeatedly, since a date at least three years prior to this epidemic, been exhorted to close this tank, but had neglected to do so. Further, during November, 1888, January, 1889, and December, 1889, 3 employees had been removed to hospital suffering from typhoid.

Exciting Cause of Outbreak.—Admixture of milk with water from the tank mentioned, which was not only subject to soakage, but also unprotected from inflow of surface water. During March, 1890, while this inquiry was under consideration, the milkman was fined for selling milk adulterated with water.

Circumstances implicating Milk.—Influence of public water supply and of sewers could be easily and certainly excluded. The milk was principally distributed within 2 municipal districts which contained 2,248 inhabited dwellings; to a less extent in 3 others. A house-to-house visitation of the 2,248 showed that 102 had been invaded between October 1st and May 31st, 1890; of those supplied with milk from the suspected source, 38 were invaded, or about 30 per cent. of all so supplied; the remainder were supplied by 58 separate traders, and of them 64 were invaded, or on an average in no case widely departed from on either side, about 2 per cent. On examining, only customers of the suspected milk in the other 3 municipalities in which they lived, it was found that in each district they also had been invaded in the proportion of 30 per cent. (the percentage of customers attacked within the 5 districts respectively varied between 26 and 31). Multiple cases in households: Of 38 households supplied with suspected milk, 15 yielded multiple cases; of 64 supplied from 58 other sources, 8 only furnished multiple cases. From February 10th to April 16th, there was a steady succession (almost day by day) of freshly-invaded households among the customers, and after April 16th no fresh invasion occurred. On March 31st to April 1st the well had been filled up.

Facts showing Special Incidence of Disease.—In 1 household the patient alone took the suspected milk, the rest some other milk. In another large household supplied from the suspected source, a majority of members disliked milk, and seldom touched it; the others were fond of it and drank large quantities. All the latter suffered, and none of the former.

Reference.—Votes and Proceedings: Legislative Assembly, New South Wales.

26.—NOTTINGHAM.

Date of Outbreak: June, 1890. *Reporter:* Dr. Boobyer, M.O.H. *Total Number of Cases:* 7. *Number of Cases amongst Drinkers of Suspected Milk:* 7. *Percentage to Total Cases:* 100. *Number of Families supplied by Milkman:* 26. *Percentage of such Families invaded:* 27.

Exciting Cause of Outbreak.—Assistant in milk business suffering from low form of fever, accompanied by vomiting, etc., and away from work for a few odd days only of the 3 weeks' duration of illness.

Circumstances implicating Milk.—All the cases in question arose in a period of 3 weeks, and were traced as having received milk from the original sufferer.

Reference.—*Public Health*, 1890-91, p. 110.

27.—EDINBURGH.

Date of Outbreak: October, 1890. *Reporter:* Dr. Harvey Littlejohn. *Total Number of Cases:* 63. *Deaths:* 3. *Number of Cases amongst Drinkers of Suspected Milk:* 56. *Percentage to Total Cases:* 89. *Number of Families supplied by Milkman:* 400 (estimated).

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Well, used for all purposes, so situate that the surface water from farmyard, byres, pigsties, and a dungheap must needs get into it. Surrounding field manured with sewage from farm dungheap. Water of well found on analysis to be of a dangerous character. Specific contamination not found. Water could be seen percolating through the roughly-constructed sides of the well. Farmstead very dirty.

Exciting Cause of Outbreak.—Not definitely demonstrated. May have been many causes at work—for example, pollution by the specific poison of enteric fever, of the well water, and thus of the milk by way of cans, pails, etc. Milk was passed into cans in a small round building aerially and closely connected with the filthy byre. On October 1st a case of enteric fever was under treatment at the farm, but only after other cases had occurred among consumers of the farm milk in the city.

Circumstances implicating Milk.—Cases of enteric fever increased with abnormal rapidity in first eight days of October, 33 coming to light, of which 25 were in consumers of this same milk. After a week cases again cropped up, until 63 cases, of which 56 were in consumers of the milk, brought this special outbreak to an end. In the last week of September 8 cases occurred in drinkers of the milk, and suspicion against it was so strong that its use was prohibited on October 4th, and the outbreak ceased after a period, which gave evidence of the wisdom of the step. Ramifications of milk service very complicated, putting difficulties in the way of elucidation of the proportion of consumers attacked. Milk served to 7 dairymen, all of whom contributed cases amid their customers, though in very varying amount and ratio. Milk oftentimes sold mixed with that from other sources. As a rule large milk drinkers were mostly attacked, and women and young adults preponderated.

Facts showing Special Incidence of Disease.—In a household of 3 members, only 1 attacked was a young adult who nightly partook of a large quantity of milk on coming home from a hard day's work.

Reference.—*Transactions of the Medico-Chirurgical Society of Edinburgh*, 1891.

28.—SHAWLAND, GLASGOW, ETC.

Date of Outbreak: August, 1891. *Reporter:* Dr. Campbell Munro, County M.O.H. *Total Number of Cases:* 42. *Deaths:* ?6. *Number of Cases amongst Drinkers of Suspected Milk:* 37. *Percentage of Total Cases:* 88.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Bad sanitary conditions existed at farm. Byre defective in structure;

dung pit in ground beside it, with drainage arrangements liable at times to pollute business water service.

Exciting Cause of Outbreak.—Daughter of farmer ill at home for some time, suffering from enteric fever. Excreta thrown into dung pit during hot weather.

Circumstances implicating Milk.—All the first 37 cases, scattered over a wide area, were of drinkers of the milk from this farm. The remaining 5 cases were of secondary infection.

Reference.—*Public Health*, 1891-92, p. 275.

29.—PLYMOUTH.

Date of Outbreak: Spring, 1892. *Reporter:* Dr. F. M. Williams, M.O.H. *Total Number of Cases:* 12. *Deaths:* 7. *Number of Cases amongst Drinkers of Suspected Milk:* 12. *Percentage to Total Cases:* 100.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived.—Well, with cover, said to be leaky, within some 40 ft. of cesspit, the latter polluted by typhoid excreta.

Exciting Cause of Outbreak.—Fever in farmer's family, the farmer and his wife engaged in dairy work, including the milking of the cows, nursing the sick, etc.

Circumstances implicating Milk.—All the 12 cases had the same milk supply. Only 2 cases cropped up after the cows had been removed to another farm.

Facts showing Special Incidence of Disease.—The fatal case was of a young man who had been ordered a milk diet.

Reference.—*BRITISH MEDICAL JOURNAL*, vol. i, 1892, p. 1157.

30.—TORQUAY AND ST. MARY CHURCH.

Date of Outbreak: August, 1892. *Reporter:* Dr. Karkeek, M.O.H. *Total Number of Cases:* 102. *Deaths:* 8. *Number of Cases amongst Drinkers of Suspected Milk:* 102. *Percentage to Total Cases:* 100. *Number of Families taking the Milk Invaded:* 54.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Well in confined back yard showing on analysis evidence of pollution.

Exciting Cause of Outbreak.—Pollution of the dairy well, though how the water became specifically contaminated has not been ascertained.

Circumstances implicating Milk.—Infection traced to agency of particular milk service in 102 persons attacked. Cases ceased to occur within twenty-one days after destruction of polluted well.

Reference.—*Report of Medical Officer of Health*.

31.—TORQUAY.

Date of Outbreak: August, 1892. *Reporter:* Dr. Karkeek, M.O.H. *Total Number of Cases:* 20. *Number of Cases amongst Drinkers of Suspected Milk:* 15. *Percentage to Total Cases:* 75. *Number of Families taking the Milk Invaded:* 8.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Two farms in question. At one a well in a small back yard proved to be so polluted as to be quite unfit for drinking purposes.

Exciting Cause of Outbreak.—At the other farm, farmer's wife, whilst nursing her son during an attack of typhoid fever, milked the cows and attended to the business of the dairy.

Circumstances implicating Milk.—After a freedom of some time from typhoid fever, cases cropped up suddenly, 6 of the first 7, and 15 in all, being in consumers of the particular milk services, excluding 5 cases not medically attended, and probably attributable to the same cause.

Facts showing Special Incidence of Disease.—One person attacked only had suspected milk in her tea. In another house only person attacked in one of the families was the servant, who alone used some of the milk in question, her employer taking milk from another source.

Reference.—*Report of Medical Officer of Health*.

32.—DUNDEE.

Date of Outbreak: August and September, 1892. *Reporter:* Dr. Anderson, M.O.H. *Total Number of Cases:* 73. *Deaths:* 11. *Number of Cases amongst Drinkers of Suspected Milk:* 43. *Percentage to Total Cases:* 59. *Number of Families taking the Milk Invaded:* 32.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Buildings old and dilapidated, and not well kept. Draw well used for washing of milk cans, although public water supply laid on to house, and tap inside cowshed.

Exciting Cause of Outbreak.—The presence of typhoid fever on a dairyman's premises.

Circumstances implicating Milk.—Only 8 cases heard of after effect of infected milk supply prior to its being stopped could be thought of as ceasing. Of 77 cases in August, 70 among consumers of milk in question, and 24 out of 45 in September. Of customers at a particular shop getting milk from infected dairy, 16 infected between August 24th and September 21st.

Reference.—*BRITISH MEDICAL JOURNAL*, vol. ii, 1892, pp. 598, 902, 915, and *Special Report of Medical Officer of Health*.

33.—GREENWICH AND ROTHERHITHE.

Date of Outbreak: September-November, 1892. *Reporter:* Dr. George Turner. *Total Number of Cases:* 511. *Percentage of Persons taking the Milk Invaded:* 91.4.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Ice cream being manufactured amid gross insanitary domestic conditions.

Exciting Cause of Outbreak.—Specific contamination of ice cream sold at street barrows by itinerant Italian vendors; and brought about probably by sewer emanations, polluted water, or by the milk used.

Circumstances implicating Milk.—In a particular area selected for house-to-house inquiry all the 61 cases of typhoid fever among the 1,551 persons were among 395 who had partaken of ice cream from one street vendor (F.), no one of the 232 persons who had eaten ices from shops being attacked.

Facts showing Special Incidence of Disease.—Two boys living in different

streets and eating ices from vendor F. were the only members to be attacked in their respective households. A servant girl who visited the infected district each Sunday, and who partook of ices also, was the only one of her mistress's family attacked.

Reference.—Practitioner, 1882, vol. ii, p. 141.

34.—LOUISVILLE, KENTUCKY, U.S.A.

Date of Outbreak: March to May, 1893. Reporters: Drs. Bailey and Tuley. Total Number of Cases: 54. Deaths: 3. Number of Cases amongst Drinkers of Suspected Milk: 44. Percentage to Total Cases: 82. Number of Families taking the Milk Invaded: About 30.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Fairly good, save that droppings, etc., from cows were swept out into a pond at the back of stable, about 12 feet below.

Exciting Cause of Outbreak.—Water used in cooling cans after they were washed, some water being left in the cans when milk poured in. Eberth bacillus found in this water.

Circumstances implicating Milk.—The epidemic ceased after stopping sale of milk.

Facts showing Special Incidence of Disease.—One case was the only one in the family who would not drink boiled milk.

Reference.—Report to State Board of Health.

35.—KELSO (SCOTLAND).

Date of Outbreak: May to August, 1893. Reporter: Dr. Oliver, County M.O.H. Total Number of Cases: 73. Deaths: 8. Number of Cases amongst Drinkers of Suspected Milk: 63. Percentage to Total Cases: 86. Number of Families Supplied by Milkman: 48. Number of such Families Invaded: 45. Percentage: 94.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Leakage from drains to well, the water of the latter being contaminated with sewage. Drains faultily laid, and one completely choked, the sewage backing up, escaping by way of holes made in a drain for rain-water pipe connections, the sewage thus set free reaching the farm well. Stoppage only discovered after the ground had been laid bare in searching for possible defects of drainage and suspected direct pollution of well.

Exciting Cause of Outbreak.—Means by which the milk received its specific infective property held to be unquestionably by way of the contaminated water supply. Two cases of illness on farm premises diagnosed as being enteric fever only after the occurrence of a third case in mid-June.

Circumstances implicating Milk.—Of the 18 cases first occurring only 1 was of a non-consumer of the milk. In the first three weeks the cases numbered 15, 15, and 22 respectively; of 48 households taking the milk only 3 escaped invasion by enteric fever. Fourteen days after stoppage of the milk supply the attacks became less numerous, and from the end of the fourth to the close of the twelfth week only 7 cases occurred.

Facts showing Special Incidence of Disease.—Three persons, not being regular customers of the dairy farm attacked by the fever, had each only one draught—namely, one a drink from the polluted well in passing, the other two a single drink of the milk.

Reference.—Annual Report for 1893 of Medical Officer of Health.

36.—PAISLEY.

Date of Outbreak: July, 1893. Reporter: Dr. Munro, Co. M.O.H. Total Number of Cases: 86. Number of Cases amongst Drinkers of Suspected Milk: 86. Percentage to Total Cases: 100.

Exciting Cause of Outbreak.—Enteric fever in home of ice-cream vendor. Patient in contact with business.

Circumstances implicating Milk.—All cases among persons eating the ice cream.

Reference.—BRITISH MEDICAL JOURNAL, 1894, vol. ii, p. 829.

37.—STOCKPORT.

Date of Outbreak: July, 1893. Reporter: Dr. Porter, M.O.H. Total Number of Cases: 9. Death: 1. Number of Cases amongst Drinkers of Suspected Milk: 9. Percentage to Total Cases: 100. Number of such Families Invaded: 9.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Milk cans rinsed at two farms—in the one with water from a dirty-looking pool in a field where the cattle grazed, in the other with water from a shallow well in proximity to a privy midden, and close to a stop water channel of imperfect construction.

Exciting Cause of Outbreak.—Probably infection of milk on vendor's premises by dust from a specifically-infected privy pit.

Circumstances implicating Milk.—Among an extensive round of consumers of the milk taken direct from the farms to their houses no cases of fever occurred, the attacks all being in the homes of customers buying milk over the counter of the vendor's shop.

Reference.—Special Report of the Medical Officer of Health. Public Health, December, 1893, January, 1894.

38.—SHILDON AND EAST THICKLEY, CO. DURHAM.

Date of Outbreak: July to September, 1893. Reporter: Dr. R. Bruce Low, L.G.B. Total Number of Cases: 45. Number of Cases amongst Drinkers of Suspected Milk: 45. Percentage to Total Cases: 100. Number of Families supplied by Milkman: 147. Number of such Families Invaded: 26. Percentage: 17.6.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Room used for storing milk had one large window opening on to three uncovered privy middens, furthest 33 feet away, nearest 23 feet; also 13 feet away an imperfectly trapped gully in yard communicating with sewer. Inside store room a sink pipe passed direct to sewer.

Exciting Cause of Outbreak.—Three undoubted cases of typhoid fever occurred on dairy premises in July and August. Milk stored all night in room exposed to emanations from sewer, which ventilated directly into room; room also open to infection from privy midden, on which were

cast the untreated bowel discharges of the dairy fever patients throughout their illness.

Circumstances implicating Milk.—The 45 cases were part of a much larger prevalence regarded as due to sewer emanations and the like. All the 45 cases were in consumers of the milk. In one locality where the milk went to 127 customers, 14.2 per cent. were attacked, as compared with less than 3 per cent. of 93 customers of another dairyman.

Facts showing special Incidence of Disease.—Attacks in adult males relatively more frequent than in females; this perhaps accounted for by the fact that the dairyman was also a publican, and frequently served the milk over the bar to add to spirits consumed there by young colliers and others.

Reference.—Report to Local Government Board.

39.—BANDON, CO. CORK.

Date of Outbreak: August, 1893. Reporter: Dr. J. Welpy. Total Number of Cases: 69. Deaths: 6. Number of Cases amongst Drinkers of Suspected Milk: 60. Percentage to Total Cases: 87. Number of Families supplied by Milkman and Number of such Families Invaded: Of 24 farms which dealt with the creamery, 12 became infected.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived: Not good; original case of fever imported from a distance.

Exciting Cause of Outbreak.—An imported case of enteric fever, which was nursed by a milkster. The milk thus contaminated was sent to a creamery. The separated milk from the latter was used in the houses in which the fever appeared.

Circumstances implicating Milk.—Almost perfect correspondence existed between the area of milk distribution from the creamery and the extent of the fever. Of the farms which did not deal with the creamery (about 180 in number), on only 2 did typhoid fever appear, and the persons who suffered on these had taken food in one of the invaded houses, so that they were indirectly affected from the common source. On the other hand, of the much smaller number (about 24) that had dealings with the creamery, 12 suffered, and from 1 of these a labourer's house had the infection conveyed to it. This house was surrounded by farms not sending milk to creamery, and from these fever was absent. Outside of the limited area dealing with the butter factory there was not, as far as known, a case of typhoid fever. Twelve farms escaped the epidemic, though they got separated milk from the creamery, but on some of these the milk was not used without boiling, and on others it was given only to young cattle and pigs.

Reference.—Lancet, vol. i, 1894.

40.—LAMBETH.

Date of Outbreak: March and April, 1894. Reporter: Dr. Verdon, M.O.H. Total Number of Cases: 59. Deaths: 10. Number of Cases amongst Drinkers of Suspected Milk: 55. Percentage to Total Cases: 93. Number of Families supplied by Milkman: Several thousands of customers.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Tank in milk storehouse yard much polluted by the dipping into it of pails from stables and cowhouses, as well as of brushes used for washing the van wheels, etc. Next to this tank stood the cauldron in which was boiled the water for can-washing.

Exciting Cause of Outbreak.—Thought of as being the access in some way of polluted water from the storehouse yard tank to the milk churns.

Circumstances implicating Milk.—All but four of the attacks were in consumers of the one milk supply, the patients residing in different parts of different sanitary areas. The milk from one small section of the business only in question, as close investigation proved. Stoppage of the supply immediately followed (allowing for incubation period) by complete collapse of the outbreak.

Facts showing Special Incidence of Disease.—Milk specially taken at one house for use of a particular inmate. He alone was attacked. In another street the only customer was attacked.

Reference.—Special Report of Medical Officer of Health. BRITISH MEDICAL JOURNAL, vol. i, 1894, p. 1148.

41.—BACUP.

Date of Outbreak: April, 1894. Reporter: Dr. J. Brown, M.O.H. Total Number of Cases: 33. Deaths: 5. Number of Cases amongst Drinkers of Suspected Milk: 30. Percentage to Total Cases: 91. Number of Families supplied by Milkman: 30. Number of such Families Invaded: 13. Percentage: 43.

Sanitary Circumstances of Farm or Dairy from which the Milk was Derived.—Dairy farmer, who milked the cows, also the night-soil scavenger; and probably conveyed the germs of the disease into his own household.

Circumstances implicating Milk.—Of the households invaded, 11 obtained milk from the same source. The supply being stopped, the outbreak came to an end.

Reference.—Annual Report for 1894.

42.—TORQUAY.

Date of Outbreak: July, 1894. Reporter: Dr. Karkeek, M.O.H. Total Number of Cases: 36. Deaths: 8. Number of Cases amongst Drinkers of Suspected Milk: 29. Percentage to Total Cases: 81. Number of such Families Invaded: 24.

Sanitary Circumstances of Farm or Dairy from which Milk was Derived.—Members of the farmer's family (who had recently come) had typhoid fever, and by some mismanagement the milk probably got specifically contaminated. Farm water supply poor in quality.

Exciting Cause of Outbreak.—Development of typhoid fever within a week of the coming of the family from Exeter, first in the farmer, and later on in his children.

Circumstances implicating Milk.—The history of the epidemic showed most unquestionably the relation of the disease to the particular milk service; and 80 per cent. of the cases were in consumers of the implicated milk.

Reference.—Report of Medical Officer of Health.

43.—GREAT HARWOOD, LANCs.

Date of Outbreak: January, 1895. *Reporter:* Dr. Sargeant, Co. M.O.H. *Total Number of Cases:* 80. *Deaths:* 5. *Number of Cases amongst Drinkers of Suspected Milk:* 80. *Percentage to Total Cases:* 100. *Number of Families supplied by Milkman:* 147. *Number of such Families invaded:* 49. *Percentage:* 33.3.

Exciting Cause of Outbreak.—Illness of dairymaid (ambulatory form of enteric fever), who milked the cows and washed the dairying utensils.

Circumstances implicating Milk.—In the invaded houses, 30 per cent. of the members were attacked. No case occurred outside the particular milk supply. The outbreak ceased, on the removal of the dairymaid, on diagnosis of her illness.

Facts showing Special Incidence of Disease.—Drinkers of raw milk attacked most virulently. One case attributed to a single glass of raw milk.

Reference.—BRITISH MEDICAL JOURNAL, vol. 1, 1895, pp. 1110-11.

44.—PLUMSTEAD.

Date of Outbreak: May-June, 1895. *Reporter:* Dr. S. Davies, M.O.H. *Total Number of Cases:* 177. *Deaths:* 23. *Number of Cases amongst Drinkers of Suspected Milk:* 159. *Percentage of Total Cases:* 90. *Number of Families supplied by Milkman:* Some 250.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Open tank in yard, exposed to pollution, and kept in uncleanly condition. Water declared on analysis to be contaminated and unfit for drinking purposes. Use in dairying operations denied.

Exciting Cause of Outbreak.—Not definitely fixable; but bacteria found in tank water closely resembling those found in milk, pointing to entry of the former to the latter.

Circumstances implicating Milk.—Outbreak sudden in its onset. Ninety per cent. of the cases in consumers of the implicated milk. In 44 houses of the 141 supplied by cart in Plumstead, 65 cases occurred. In one road 49 houses took the milk, and 29 suffered invasion. Of 150 other houses near, and not taking the particular milk, only 2 had fever cases. Epidemic declined rapidly two weeks after closure of the dairy.

Facts showing Special Incidence of Disease.—One patient infected by drinking the milk (not her household service) when calling upon her mother.

Reference.—Public Health, January, 1896.

45.—RAHAN DISPENSARY DISTRICT, CO. CORK.

Date of Outbreak: 1895 (1st half). *Reporter:* Dr. O Connor. *Total Number of Cases:* 6. *Deaths:* 2. *Number of Cases amongst Drinkers of Suspected Milk:* 6. *Percentage to Total Cases:* 100. *Number of Families Supplied by Milkman:* Many, with "separated milk." *Number of such Families invaded:* 6.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Milk obtained from a large country district for the creamery at Mallow, probably from a radius of 20 miles round, and from many farmers.

Exciting Cause of Outbreak.—The "separated milk" which the farmers get to return is used for making bread at home, which is eaten by the family. The outside of the bread may be safe, but not the inner portions, the heat not being sufficient to destroy microbes.

Circumstances implicating Milk.—In each case the fact of the person attacked having used creamery milk was clearly proved.

Reference.—Cork Constitution, August 20th, 1895.

46.—ST. HELENS, LANCs.

Date of Outbreak: November, 1895. *Reporter:* Dr. Robertson, M.O.H. *Total Number of Cases:* 12. *Deaths:* 2. *Number of Cases amongst Drinkers of Suspected Milk:* 12. *Percentage to Total Cases:* 100. *Number of Families supplied by Milkman:* 77. *Number of such Families invaded:* 8. *Percentage:* 22.

Sanitary Circumstances of Farm or Dairy from which Milk was derived. Shippon in a filthy state; contained pigs and cows; floor rubble paved; gully in shippon, which was inches deep in animal manure. Water supply bad.

Exciting Cause of Outbreak.—Milk exposed to specifically polluted air, and taken direct from the shippon to the cart. Relative of the milk dealer ill with typhoid fever three weeks after notification of first case. Connection with dairying operations denied.

Circumstances implicating Milk.—All the cases occurred shortly after the insanitary premises began to be used as a cowshed, and they ceased when the milk service was stopped.

Reference.—Special Report of Medical Officer of Health.

47.—WARMINSTER, WILTS.

Date of Outbreak: 1895. *Reporter:* Dr. Flower, M.O.H. *Total Number of Cases:* 47. *Deaths:* 3. *Number of Cases amongst Drinkers of Suspected Milk:* 34. *Percentage to Total Cases:* 72. *Number of Families taking the Milk invaded:* 29.

Sanitary Circumstances of Farm or Dairy from which Milk was derived.—Brook highly contaminated with sewage running through the grazing meadow.

Exciting Cause of Outbreak.—Cows drank of the sewage-polluted stream. Cows milked in the meadow in circumstances which may have led to pollution of the milk by the water of the brook. Persons using the milk spoke of its putrid and "ropy" condition on two or three occasions.

Circumstances implicating Milk.—The disease was entirely confined to the locality served by the implicated milk, with the exception of 2 cases that were imported into the town, 11 cases being of persons constantly in association with infected-milk drinkers.

Reference.—Special Report of Medical Officer of Health.

48.—KIRKCALDY.

Date of Outbreak: May, 1896. *Reporter:* Dr. Mackay, M.O.H. *Total Number of Cases:* 191. *Deaths:* 20.

Sanitary Circumstances of Farm or Dairy from which the Milk was derived.—Apparently good.

Exciting Cause of Outbreak.—Not discovered. *Circumstances implicating Milk.*—Scarcely a household into which the milk was introduced escaped invasion by fever. Intensity diminished as a rule inversely as the distance from the dairy. The epidemic ceased after closure of the dairy.

Reference.—Cowkeeper and Dairyman's Journal, October, 1896.

ERNEST HART.